Such cleaning compositions are characterized by superior grease stain removal performance under cold water conditions.

Abstract:

The present invention relates to a cleaning composition, preferably a liquid cleaning composition adapted for direct application to fabrics or hard surfaces, which comprises a first and second phase changing materials (PCMs) of different melting temperatures, a surfactant and an organic solvent. Such cleaning composition is characterized by superior grease stain removal performance under cold water conditions.
CLEANING COMPOSITIONS CONTAINING PHASE CHANGING MATERIALS (PCMs) FOR COLD WATER GREASE STAIN REMOVAL

FIELD OF THE INVENTION

The present invention relates to a cleaning composition, and a liquid cleaning composition adapted for direct application to fabrics or hard surfaces. Such cleaning composition contains a first and second phase changing materials (PCMs) of different melting temperatures, a surfactant, and an organic solvent. Such cleaning composition is characterized by superior grease stain removal performance under cold water conditions.

BACKGROUND OF THE INVENTION

Cold water grease cleaning has been a challenge for fabric and home care products, mainly due to two reasons: (1) surfactants and other cleaning actives in the detergent system become less effective at lower washing temperatures; and (2) grease may become more viscous due to crystallization at lower washing temperatures, thereby rendering it harder to remove.

Currently, most research effort is focused on improving effectiveness of the detergent system under cold water washing conditions, but little or no effort has been devote to interfere with grease crystallization and reduce the viscosity increase to allow easier removal of the grease from fabric surface or hard surfaces.

Accordingly, there is a need for a cleaning composition that contains ingredients that can effectively prevent or hinder formation of microcrystals in grease when the temperature decreases. In this matter, viscosity of grease can be reduced at lower washing temperatures, thereby rendering it easier to be removed.

SUMMARY OF THE INVENTION

The present invention relates to a cleaning composition which contains Phase Changing Materials (PCMs), which can improve the cold water grease removal performance of an existing detergent system by interfering with the grease crystallization process at lower washing temperatures. The PCMs are substances having high fusion heat, which, upon undergoing a phase change, is capable of storing or releasing large amounts of energy per mass. For example, the PCMs will melt when the local temperature increases from a lower point to above the PCMs’ melting point, and such melting will lead to energy storage by the PCMs. For another example, the PCMs will freeze when the local temperature decreases from a higher point to below the PMC’s melting point, and such freezing will lead to energy release by the PCMs. Such energy
storage or release by the PCMs function to provide a local temperature buffer to reduce grease crystallization and allow effective removal of the grease at lower washing temperatures.

One specific aspect of the present invention relates to a cleaning composition comprising:

(a) from 0.5 wt% to 98.5 wt% of a first phase changing material (PCM) having a first, higher melting temperature, wherein said first PCM is selected from the group consisting of: (i) esters formed by esterification reaction between $C_{10}$-$C_{20}$ carboxylic acids and $C_{1}$-$C_{6}$ alcohols, (ii) linear or branched $C_{8}$-$C_{20}$ fatty acids, and mixtures thereof;

(b) from 0.5 wt% to 98.5 wt% of a second phase changing material (PCM) having a second, lower melting temperature, wherein said second PCM is selected from the group consisting of $C_{10}$-$C_{40}$ alkanes, $C_{10}$-$C_{40}$ alkenes, $C_{10}$-$C_{40}$ alkynes, and mixtures thereof;

(c) from 0.5 wt% to 50 wt% of at least one surfactant selected from the group consisting of anionic surfactants, cationic surfactants, nonionic surfactants, amphoteric surfactants, and mixtures thereof; and

(d) from 0.5 wt% to 98.5 wt% of at least one organic solvent having a Partition Coefficient (LogP) ranging from -1 to 3.5, wherein said organic solvent is selected from the group consisting of glycol ethers, glycol ether esters, and mixtures thereof,

wherein the weight ratio of said at least one organic solvent over said at least one surfactant is greater than 1:1, wherein said composition has a moisture content of less than 3 wt%.

The presence of two or more different PCMs having different melting temperatures provide a broader temperature buffer range for interfering with the grease crystallization and allow more effective cold water grease cleaning under different washing temperatures. Further, the relatively high solvent-to-surfactant ratio provides a facility for co-formulation of varied surfactant types and PCMs without phase separation. The low moisture or water content ensures permeation and fractionation of the grease substrate by the composition.

Another specific aspect of the present invention relates to a cleaning composition comprising:

(a) from 0.5 wt% to 10 wt%, preferably from 1 wt% to 7 wt%, and more preferably from 3 wt% to 5 wt%, of butyl stearate;

(b) from 0.5 wt% to 10 wt%, preferably from 1 wt% to 7 wt%, and more preferably from 3 wt% to 5 wt%, of tetradecane;
(c) from 0.5 wt% to 10 wt%, preferably from 1 wt% to 7 wt%, and more preferably from 3 wt% to 5 wt%, of pentadecane;
(d) from 0.5 wt% to 10 wt%, preferably from 1 wt% to 7 wt%, and more preferably from 3 wt% to 5 wt%, of dodecane;
(e) from 5 wt% to 50 wt%, preferably from 10 wt% to 30 wt%, and more preferably from 15 wt% to 20 wt%, of a nonionic surfactant that is a C\textsubscript{12}-C\textsubscript{15} alkyl ethoxylated alcohol having a weight average degree of ethoxylation ranging from 5 to 10; and
(f) from 5 wt% to 50 wt%, preferably from 10 wt% to 30 wt%, and more preferably from 15 wt% to 20 wt%, of an anionic surfactant that is a C\textsubscript{10}-C\textsubscript{12} linear alkylbenzene sulphonate (LAS);
(g) from 20 wt% to 90 wt%, preferably from 30 wt% to 70 wt%, and more preferably from 40 wt% to 60 wt%, of an organic solvent that is dipropylene glycol n-butyl ether,

wherein the weight ratio of \((g)/[(e)+(f)]\) is greater than 1, wherein said composition has a moisture content of less than 3 wt%.

Yet another aspect of the present invention relates to a cleaning composition comprising:
(a) from 0.1 wt% to 5 wt%, preferably from 0.5 wt% to 4 wt%, and more preferably from 1.5 wt% to 2 wt%, of capric acid;
(b) from 0.1 wt% to 5 wt%, preferably from 1 wt% to 4 wt%, and more preferably from 2 wt% to 2.5 wt% of lauric acid;
(c) from 0.5 wt% to 10 wt%, preferably from 1 wt% to 7 wt%, and more preferably from 3 wt% to 5 wt%, of tetradecane;
(d) from 0.5 wt% to 10 wt%, preferably from 1 wt% to 7 wt%, and more preferably from 3 wt% to 5 wt%, of pentadecane;
(e) from 0.5 wt% to 10 wt%, preferably from 1 wt% to 7 wt%, and more preferably from 3 wt% to 5 wt%, of dodecane;
(f) from 5 wt% to 50 wt%, preferably from 10 wt% to 30 wt%, and more preferably from 15 wt% to 20 wt%, of a nonionic surfactant that is a C\textsubscript{12}-C\textsubscript{15} alkyl ethoxylated alcohol having a weight average degree of ethoxylation ranging from 5 to 10; and
(g) from 5 wt% to 50 wt%, preferably from 10 wt% to 30 wt%, and more preferably from 15 wt% to 20 wt%, of an anionic surfactant that is a C₆₋₇-C₂₀ linear alkylbenzene sulphonate (LAS);
(h) from 20 wt% to 90 wt%, preferably from 30 wt% to 70 wt%, and more preferably from 40 wt% to 60 wt%, of an organic solvent that is dipropylene glycol n-butyl ether,

wherein the weight ratio of (h)/[(f)+(g)] is greater than 1, wherein said composition has a moisture content of less than 3 wt%.

These and other features of the present invention will become apparent to one skilled in the art upon review of the following detailed description when taken in conjunction with the appended claims.

DETAILED DESCRIPTION OF THE INVENTION

Definitions

As used herein, the term "cleaning composition" means a liquid or solid composition for treating fabrics, hard surfaces and any other surfaces in the area of fabric and home care, and includes hard surface cleaning and/or treatment including floor and bathroom cleaners (e.g., toilet bowl cleaners); hand dishwashing agents or light duty dishwashing agents, especially those of the high-foaming type; machine dishwashing agents; personal care compositions; pet care compositions; automotive care compositions; and household care compositions. In a preferred embodiment, the cleaning composition of the present invention is a liquid cleaning composition, which is adapted for direct application to fabric surfaces (e.g., as a pre-treat laundering composition) or hard surfaces (e.g., as a dish washing detergent, especially a hand washing composition for dish).

As used herein, the term "Phase Changing Material" refers to a material that is capable of transitioning between different phases, e.g., solid-liquid, solid-gas, liquid-gas, or amorphous-crystalline phases, while releasing or absorbing a significant amount of heat.

As used herein, articles such as "a" and "an" when used in a claim, are understood to mean one or more of what is claimed or described.

As used herein, the terms "comprising," "comprises," "include", "includes" and "including" are meant to be non-limiting. The term "consisting of" or "consisting essentially of" are meant to be limiting, i.e., excluding any components or ingredients that are not specifically listed except when they are present as impurities. The term "substantially free of" as used herein
refers to either the complete absence of an ingredient or a minimal amount thereof merely as
impurity or unintended byproduct of another ingredient.

As used herein, the term "liquid" refers to a fluid having a liquid having a viscosity of
from about 1 to about 2000 mPa*s at 25°C and a shear rate of 20 sec⁻¹. In some embodiments,
the viscosity of the liquid may be in the range of from about 200 to about 1000 mPa*s at 25°C at
a shear rate of 20 sec⁻¹. In some embodiments, the viscosity of the liquid may be in the range of
from about 200 to about 500 mPa*s at 25°C at a shear rate of 20 sec⁻¹.

All temperatures herein are in degrees Celsius (°C) unless otherwise indicated. Unless
otherwise specified, all measurements herein are conducted at room temperature and under the
standard atmospheric pressure.

In all embodiments of the present invention, all percentages are by weight of the total
composition, unless specifically stated otherwise. All ratios are weight ratios, unless specifically
stated otherwise. The dimensions and values disclosed herein are not to be understood as being
strictly limited to the exact numerical values recited. Instead, unless otherwise specified, each
such dimension is intended to mean both the recited value and a functionally equivalent range
surrounding that value. For example, a dimension disclosed as "40 mm" is intended to mean
"about 40 mm."

Phase Changing Materials (PCMs)

The cleaning composition of the present invention contains at least two PCMs of different
melting temperatures. Preferably, the two PCMs have a melting temperature difference of at
least 10°C, preferably at least 15°C, more preferably at least 20°C, and most preferably at least
25°C.

The first PCM may have a melting temperature ranging from about 15°C to about 50°C,
preferably from about 20°C to about 45°C, and more preferably from about 20°C to about 40°C.

Examples of the first PCM include esters formed by esterification reaction between Cio-
C₂₀ carboxylic acids and C₁-C₆ alcohols, preferably esters of C₄₀-C₂₀ fatty acids and C₁-C₅
alcohols, such as methyl caprate, ethyl caprate, propyl caprate, butyl caprate, pentyl caprate,
hexyl caprate, methyl laurate, ethyl laurate, propyl laurate, butyl laurate, pentyl laurate, hexyl
laurate, methyl myristate, ethyl myristate, propyl myristate, butyl myristate, pentyl myristate,
hexyl myristate, methyl palmitate, ethyl palmitate, propyl palmitate, butyl palmitate, pentyl
palmitate, hexyl palmitate, methyl stearate, ethyl stearate, propyl stearate, butyl stearate, pentyl
stearate, hexyl stearate, methyl oleate, ethyl oleate, propyl oleate, butyl oleate, pentyl oleate,
hexyl oleate, methyl linoleate, ethyl linoleate, propyl linoleate, butyl linoleate, pentyl linoleate, hexyl linoleate, methyl arachidate, ethyl arachidate, propyl arachidate, butyl arachidate, pentyl arachidate, hexyl arachidate, and mixtures thereof. In a preferred embodiment of the present invention, the first PCM is an ester of a C_{14}-C_{8} carboxylic acid (preferably a fatty acid) and a C_{4}-C_{8} alcohol. In a most preferred embodiment of the present invention, the first PCM is butyl stearate.

The first PCM can also be selected from linear or branched C_{8}-C_{20} fatty acids, such as caprylic acid, capric acid, lauric acid, myristic acid, myristoleic acid, palmitic acid, palmitoleic acid, stearic acid, oleic acid, linoleic acid, arachidic acid, arachidonic acid, pristane acid, phytanic acid, and mixtures thereof. In a preferred embodiment of the present invention, the first PCM is a mixture of two or more different C_{10}-C_{18} fatty acids. In a most preferred embodiment of the present invention, the first PCM is a mixture of capric acid and lauric acid, preferably at a weight ratio ranging from 10:90 to 90:10, more preferably from 20:80 to 50:50, and most preferably from 40:60 to 45:55.

The first PCM may be present in the cleaning composition of the present invention in an amount ranging from 0.5 wt% to 98.5 wt%, preferably from 1 wt% to 30 wt%, more preferably from 2 wt% to 10 wt%, and most preferably from 3 wt% to 5 wt%.

The second PCM may have a melting temperature ranging from about -15°C to about 20°C, preferably from about -10°C to about 15°C, and more preferably from about 0°C to about 10°C.

The second PCM may be selected from the group consisting of: linear, branched, or cyclic C_{10}-C_{20} alkanes; linear, branched, or cyclic C_{10}-C_{20} alkenes; linear, branched, or cyclic C_{10}-C_{20} alkynes, and mixtures thereof. Non-limiting examples of the second PCM include: dodecane, tridecane, tetradecane, pentadecane, hexadecane, cyclohexadecane, 1-pentadecene, 1-hexadecene, 1-heptadecene, 1-hexadecyne, and mixtures thereof. In a preferred embodiment of the present invention, the second PCM is selected from the group consisting of C_{10}-C_{20} alkanes and mixtures thereof. More preferably, the second PCM is selected from the group consisting of dodecane, tetradecane, pentadecane, and mixtures thereof. In a most preferred embodiment of the present invention, the second PCM is a mixture of dodecane, tetradecane, and pentadecane, preferably at weight ratios ranging from 1:2.5 to 5:2:1, more preferably from 1:1.5:2 to 2:1.5:1, and most preferably at about 1:1:1.
The second PCM may be present in the cleaning composition of the present invention in an amount ranging from 0.5 wt% to 98.5 wt%, preferably from 1 wt% to 30 wt%, more preferably from 2 wt% to 10 wt%, and most preferably from 3 wt% to 5 wt%.

**Organic Solvents**

The cleaning composition of the present invention also contains one or more organic solvents as carriers for the PCMs, in order to dissolve the PCMs and enable penetration of the PCMs into grease structure to interfere with crystallization of the grease during the wash.

Suitable organic solvents have a Partition Coefficient (LogP) ranging from about -1 to about 3.5, preferably from 0 to 3, more preferably from 0.5 to 2, and most preferably from 0.6 to 1.5. The LogP values of various organic solvents are as reported by cf. Staples and Davis (2002).

Non-limiting examples of organic solvents suitable for practice of the present invention include glycol ethers and glycol ether esters, such as ethylene glycol propyl ether, ethylene glycol n-butyl ether, ethylene glycol hexyl ether, diethylene glycol methyl ether, diethylene glycol ethyl ether, diethylene glycol n-butyl ether, diethylene glycol hexyl ether, triethylene glycol methyl ether, triethylene glycol ethyl ether, triethylene glycol n-butyl ether, propylene glycol methyl ether, propylene glycol dimethyl ether, propylene glycol n-propyl ether, dipropylene glycol n-propyl ether, propylene glycol n-butyl ether, dipropylene glycol n-butyl ether, ethylene glycol phenyl ether, propylene glycol phenyl ether, ethylene glycol n-butyl ether acetate, diethylene glycol n-butyl ether acetate, propylene glycol methyl ether acetate, dipropylene glycol methyl ether acetate, propylene glycol diacetate, and mixtures thereof. Preferred organic solvents are selected from the group consisting of dipropylene glycol methyl ether acetate, propylene glycol n-propyl ether, dipropylene glycol n-propyl ether, propylene glycol n-butyl ether, dipropylene glycol n-butyl ether, propylene glycol phenyl ether, and mixtures thereof. The most preferred organic solvent is dipropylene glycol n-butyl ether.

The above-described organic solvent(s) can be present in an amount ranging from 0.5 wt% to 98.5 wt%, preferably from 10 wt% to 80 wt%, more preferably from 30 wt% to 70 wt%, and most preferably from 40 wt% to 60 wt%, in the cleaning composition of the present invention.

The cleaning composition of the present invention may further comprise additional non-aqueous solvent(s) selected from the group consisting of: linear or branched lower C1-C8 alcohols, diols, glycerols or glycols; lower amine solvents such as C1-C4 alkanolamines, and
mixtures thereof. Exemplary organic solvents include 1,2-propanediol, ethanol, glycerol, monoethanolamine and triethanolamine.

**Surfactants**

Cleaning compositions of the present invention comprise one or more surfactants, which enables more effective delivery and penetration of the PCMs into the grease structure. The surfactants can be present at amounts ranging from about 0.5 wt% to 50 wt%, preferably from 1 wt% to about 45 wt%, more preferably from about 5 wt% to about 40 wt%, and more preferably from about 10% to about 35% by total weight of the compositions.

Detergent surfactants utilized can be of the anionic, cationic, nonionic, or amphoteric type or can comprise compatible mixtures of these types.

Nonionic and anionic surfactants are preferred. Preferred nonionic surfactants are those of the formula \( R^1(OC_2H_4)_nOH \), wherein \( R^1 \) is a \( C_8 \sim C_{18} \) alkyl group or alkyl phenyl group, and \( n \) is from about 1 to about 80. Particularly preferred are \( C_8 \sim C_{18} \) alkyl alkoxylated alcohols having a weight average degree of alkoxylation from 1 to 20, and more preferred are \( C_{12} \sim C_{18} \) alkyl ethoxylated alcohols having a weight average degree of ethoxylation from 5 to 10. The nonionic surfactants can be provided in the cleaning compositions at levels ranging from 5 wt% to 50 wt%, preferably from 10 wt% to 30 wt%, and more preferably from 15 wt% to 20 wt%.

Useful anionic surfactants can themselves be of several different types. For example, water-soluble salts of the higher fatty acids, i.e., "soaps", are useful anionic surfactants in the compositions herein. This includes alkali metal soaps such as the sodium, potassium, ammonium, and alkyl ammonium salts of higher fatty acids containing from about 8 to about 24 carbon atoms, and preferably from about 12 to about 18 carbon atoms. Soaps can be made by direct saponification of fats and oils or by the neutralization of free fatty acids. Particularly useful are the sodium and potassium salts of the mixtures of fatty acids derived from coconut oil and tallow, i.e., sodium or potassium tallow and coconut soap. Additional non-soap anionic surfactants which are suitable for use herein include the water-soluble salts, preferably the alkali metal, and ammonium salts, of organic sulfuric reaction products having in their molecular structure an alkyl group (included in the term "alkyl" is the alkyl portion of acyl groups) containing from about 10 to about 20 carbon atoms and a sulfonic acid or sulfuric acid ester group. Examples of this group of synthetic anionic surfactants include, but are not limited to: a) the sodium, potassium and ammonium alkyl sulfates with either linear or branched carbon chains, especially those obtained by sulfating the higher alcohols (\( C_{10} \sim C_{20} \) carbon atoms), such as those produced...
by reducing the glycerides of tallow or coconut oil; b) the sodium, potassium and ammonium alkylethoxy sulfates with either linear or branched carbon chains, particularly those in which the alkyl group contains from about 10 to about 20, preferably from about 12 to about 18 carbon atoms, and wherein the ethoxylated chain has, in average, a degree of ethoxylation ranging from about 0.1 to about 5, preferably from about 0.3 to about 4, and more preferably from about 0.5 to about 3; c) the sodium and potassium alkyl benzene sulfonates in which the alkyl group contains from about 10 to about 20 carbon atoms in either a linear or a branched carbon chain configuration, preferably a linear carbon chain configuration; d) the sodium, potassium and ammonium alkyl sulphonates in which the alkyl group contains from about 10 to about 20 carbon atoms in either a linear or a branched configuration; e) the sodium, potassium and ammonium alkyl phosphates or phosphonates in which the alkyl group contains from about 10 to about 20 carbon atoms in either a linear or a branched configuration, f) the sodium, potassium and ammonium alkyl carboxylates in which the alkyl group contains from about 10 to about 20 carbon atoms in either a linear or a branched configuration, and combinations thereof. Especially preferred for the practice of the present invention are surfactant systems containing C10-C20 linear alkyl benzene sulphonates, C10-C20 linear or branched alkylethoxy sulfates having an average degree of ethoxylation ranging from 0.1 to about 5 (preferably from about 0.3 to about 4 and more preferably from about 0.5 to about 3), or mixtures thereof. The most preferred anionic surfactants for the practice of the present invention are C10-C20 linear alkyl benzene sulphonates.

The anionic surfactants can be provided in the cleaning compositions of the present invention at levels ranging from 5% to about 50%, more preferably from about 10% to about 30%, and more preferably from about 15% to about 20% by total weight of the compositions.

Other surfactants useful herein include amphoteric surfactants and cationic surfactants. Such surfactants are well known for use in laundry detergents and are typically present at levels from about 0.2 wt% or 1 wt% to about 20 wt% or 30 wt%.

**Cleaning Compositions**

The present invention provides a cleaning composition comprising the PCMs, the organic solvent, and the surfactant(s) as mentioned hereinabove. In one aspect, the cleaning composition is suitable for laundry detergent application, for example: laundry, including automatic washing machine laundering or hand-washing, or cleaning auxiliaries, such as for example, rinse aids, additives or pre-treat types. The cleaning composition is particularly suitable as a pre-laundering treatment composition for direct application to fabric surface that have grease stains, so as to alter
the grease structure and enable easier removal thereof under cold water conditions in subsequent wash cycle. In another aspect, the cleaning composition can be hard surface cleaners, such as for example, dish washing detergents, kitchen counter detergents, bathroom or toilet bowl cleaners.

The cleaning compositions can be in any form, namely, in the form of a liquid; a solid such as a powder, granules, agglomerate, paste, tablet, pouches, bar, gel; an emulsion; types delivered in dual- or multi-compartment containers or pouches; a spray or foam detergent; premoistened wipes (i.e., the cleaning composition in combination with a nonwoven material); dry wipes (i.e., the cleaning composition in combination with a nonwoven material) activated with water by a consumer; and other homogeneous or multiphase consumer cleaning product forms.

The cleaning composition is preferably a liquid composition. Liquid compositions contained in encapsulated and/or unitized dose products are included, as are compositions which comprise two or more separate but jointly dispensable portions. The liquid cleaning composition of the present invention has a viscosity from about 1 to about 2000 centipoise (1-2000 mPa-s), or from about 200 to about 800 centipoises (200-800 mPa-s). The viscosity can be determined using a Brookfield viscometer, No. 2 spindle, at 60 RPM/s, measured at 25°C.

Additional Cleaning Actives

The cleaning composition may further contain from about 5 wt% to about 70 wt%, or about 10 wt% to about 60 wt% adjunct cleaning actives. Suitable adjunct cleaning actives include: transition metal catalysts; imine bleach boosters; enzymes such as amylases, carbohydrases, cellulases, laccases, lipases, bleaching enzymes such as oxidases and peroxidases, proteases, pectate lyases and mannanases; source of peroxygen such as percarbonate salts and/or perborate salts, preferred is sodium percarbonate, the source of peroxygen is preferably at least partially coated, preferably completely coated, by a coating ingredient such as a carbonate salt, a sulphate salt, a silicate salt, borosilicate, or mixtures, including mixed salts, thereof; bleach activator such as tetraacetyl ethylene diamine, oxybenzene sulphonate bleach activators such as nonanoyl oxybenzene sulphonate, caprolactam bleach activators, imide bleach activators such as N-nonanoyl-N-methyl acetamide, preformed peracids such as N,N-phthalamino peroxyacaproic acid, nonylamido peroxyadipic acid or dibenzoyl peroxide; suds suppressing systems such as silicone based suds suppressors; brighteners; hueing agents; photobleach; fabric-softening agents such as clay, silicone and/or quaternary ammonium compounds; flocculants such as polyethylene oxide; dye transfer inhibitors such as polyvinylpyrrolidone, poly 4-vinylpyridine N-oxide and/or
co-polymer of vinylpyrrolidone and vinylimidazole; fabric integrity components such as
oligomers produced by the condensation of imidazole and epichlorhydrin; soil dispersants and
soil anti-redeposition aids such as alkoxylated polyamines and ethoxylated ethyleneimine
polymers; anti-redeposition components such as polyesters and/or terephthalate polymers,
polyethylene glycol including polyethylene glycol substituted with vinyl alcohol and/or vinyl
acetate pendant groups; perfumes such as perfume microcapsules, polymer assisted perfume
delivery systems including Schiff base perfume/polymer complexes, starch encapsulated perfume
accords; soap rings; aesthetic particles including coloured noodles and/or needles; dyes; fillers
such as sodium sulphate, although it may be preferred for the composition to be substantially free
of fillers; carbonate salt including sodium carbonate and/or sodium bicarbonate; silicate salt such
as sodium silicate, including 1.6R and 2.0R sodium silicate, or sodium metasilicate; co-polymers
of di-carboxylic acids and diols; cellulosic polymers such as methyl cellulose, carboxymethyl
cellulose, hydroxyethoxy cellulose, or other alkyl or alkylalkoxy cellulose, and hydrophobically
modified cellulose; carboxylic acid and/or salts thereof, including citric acid and/or sodium
citrate; and any combination thereof.

**Test Method 1: Measurement of the Melting Temperature of PCMs**

Samples are prepared at room temperature to between 5 and 10 wt% of PCMs in a grease
substrate. Sample weights of between 5 and 10 mg are used at each measurement. The DSC
procedure then begins:

1. Sample are equilibrated at 80°C
2. Sample held isothermally for 2 minutes
3. Sample are ramped at 5°C/minute to -50°C
4. Sample ramped at 5°C to 80°C

Melting temperatures are identified as endothermic peaks on the thermogram.

**EXAMPLES**

1. Comparative Fabric Stain Removal Test (Using Fast Wash Method)

   This test is intended to measure the ability of a cleaning composition to remove a stain
   from a fabric. Ordinarily, stain removal is reported via an index, i.e. SRI and is evaluated by
   image analysis after a single wash. The index is drawn from the L-A-B color space
   measurements of fabric under standard illuminant conditions Daylight-65 (D65) as agreed by the
   "Commission International de l'Eclairage" (CIE) - briefly, this is the illumination of the midday
sun in Northern Europe. The index is designed to be at 100% for complete removal and at 0% for no removal.

The steps for assaying the whiteness maintenance of the laundry detergent composition of the present invention are as follows:

1. Four (4) sample pretreatment compositions are prepared, which include: (A) a high-solvent formulation with a solvent/surfactant ratio of greater than 1 but without any added water ("PP HiSolv"); (B) a high-surfactant formulation with a solvent/surfactant ratio of less than 1 and without any added water ("PP HiSurf"); (C) a high-solvent/high-water formulation with a solvent/surfactant ratio of greater than 1 and 10 wt% of added water ("PP 90% HiSolv - 10%w"); and (D) a high-solvent/low-water formulation with a solvent/surfactant ratio of greater than 1 and 1 wt% of added water ("PP 99% HiSolv - 1%w"). The detailed compositional breakdown of these sample pretreatment compositions are listed below in Table 1:

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butyl stearate</td>
<td>4%</td>
<td>4%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Tetradecane</td>
<td>4%</td>
<td>4%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Pentadecane</td>
<td>4%</td>
<td>4%</td>
<td>0%</td>
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<td>Dodecane</td>
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<td>5%</td>
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<td>NI</td>
<td>17%</td>
<td>29%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Distilled Water</td>
<td>0%</td>
<td>0%</td>
<td>10%</td>
<td>1%</td>
</tr>
<tr>
<td>PP HiSolv (A)</td>
<td>0%</td>
<td>0%</td>
<td>90%</td>
<td>99%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

2. Preparation of water:

- Into a 1 L beaker, add 0.28 g CaCl$_2$·2H$_2$O and 0.13 g MgCl$_2$·6H$_2$O. Add 800 mL of DI water. Using a stir bar and stirring plate, stir the solution until the mixture is dissolved and the solution turns clear. Pour the solution into a 1 L volumetric flask and fill to 1 L line with DI water. The rinse water should be maintained at 4 degrees C until use in step 7.
- Add 10ml demi-water to the tubes for rinsing; the rinse water should be maintained at 4 degrees C until use in step 7.
(3) Transfer 20 mL of the PP HiSolv solution (A) into 50 mL plastic vials (4 tubes for each pretreatment prototype). Add clean magnets for additional agitation.

(4) Test fabrics are selected from 1 cm diameter CFT Beef Fat Stains (CS-61) purchased from the Center for Testing Materials B.V. (Vlaardingen, Netherlands).

(5) To pretreat the stains, prepare as follows:
   a. Take a Polystyrene-sealed ice box equilibrated to a -20 freezer
   b. Place the 1 cm diameter stain(s) onto a flat piece of aluminum foil, place foil on balance and tare the balance
   c. Apply a little at a time e.g. 1-2 droplets ~0.063g and spread the sample over the entire circle —can use the dropper to accelerate the spread. Let the balance equilibrate before adding an extra drop. Ensure that for any group of 8 stains, the total weight added is no greater than 0.5g

(6) To each plastic vial, add two of the pretreated CFT Beef Fat stained fabrics and 4 each of the following 1 cm circles of un-brightened fabric: Egyptian cotton, polyester, knitted cotton and terry towel (ballast material).

(7) Invert all tubes together and place on the wrist shaker clamped about 1/2 way up the tube. Secure the 50 mL wash vial tightly to Wrist Action Shaker Model 75 (Burrell Scientific, Pittsburgh, Pennsylvania). Use a timer and run the wash for 40 minutes at an amplitude setting of 10.

(8) After the wash is complete, place the tubes in the centrifuge and centrifuge samples for 5 minutes at around 1500 rpm

(9) After centrifuging, keep the tubes upright and transfer the plastic inserts with all fabrics and ballast material into the rinsing tubes and cap tightly

(10) Invert all samples together and place onto wrist shaker and shake for 3 minutes.

(11) After rinsing, put samples again into the centrifuge and spin at 1500 rpm for a further 5 minutes.

(12) Remove fabrics from plastic inserts and place in a labeled 24 well plate. Make sure the fabrics are as spread out as possible. Place cups in 40°C oven overnight for drying.

(13) Measure the color of fabrics using the DigiEye with a D65 illumination

(14) Label the 24-well plate according to the sample ordering.

(15) The Stain Removal Index is calculated as follows:
\[ dSRI = \frac{(dE_f - dE_i)}{dE_i} \times 100 \]

Figure 1 is a graph showing the SRI values of the four pre-treat compositions described hereinabove in Table 1. It is clear that the inventive pre-treat compositions containing the PCMs, the desired organic solvent-to-surfactant ratio, and the low water content exhibit superior grease stain removal performance under cold water conditions over comparative pre-treat compositions that either do not contain the PCMs, or has an organic solvent-to-surfactant ratio that is too long, or has a water content that is too high.

### II. Exemplary Pre-Laundering Treatment Compositions

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<td>A</td>
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<tr>
<td>Butyl stearate</td>
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<tr>
<td>Capric acid (45 wt%) and lauric acid (55 wt%) mixture</td>
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<td>4%</td>
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<tr>
<td>Tetradecane</td>
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<td>4%</td>
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<tr>
<td>Pentadecane</td>
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<td>Dodecane</td>
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<td>4%</td>
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<tr>
<td>Dipropylene glycol n-butyl ether (DPnB)</td>
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<td>50%</td>
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<td>LAS</td>
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<td>17%</td>
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<tr>
<td>NI (C_{12-18}AE_2)</td>
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<td>TOTAL</td>
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### III. Exemplary Dish Detergent Compositions

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<td>AES</td>
<td>21%</td>
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While particular embodiments of the present invention have been illustrated and described, it would be obvious to those skilled in the art that various other changes and modifications can be made without departing from the spirit and scope of the invention. It is therefore intended to cover in the appended claims all such changes and modifications that are within the scope of this invention.
What is claimed is:

1. A cleaning composition comprising:
   (a) from 0.5 wt% to 98.5 wt% of a first phase changing material (PCM) having a first, higher melting temperature, wherein said first PCM is selected from the group consisting of: (i) esters formed by esterification reaction between \( \text{C}_{10}-\text{C}_{20} \) carboxylic acids and \( \text{C}_{1}-\text{C}_{5} \) alcohols, (ii) linear or branched \( \text{C}_{8}-\text{C}_{20} \) fatty acids, and mixtures thereof;
   (b) from 0.5 wt% to 98.5 wt% of a second phase changing material (PCM) having a second, lower melting temperature, wherein said second PCM is selected from the group consisting of \( \text{C}_{10}-\text{C}_{40} \) alkanes, \( \text{C}_{10}-\text{C}_{40} \) alkenes, \( \text{C}_{10}-\text{C}_{40} \) alkynes, and mixtures thereof;
   (c) from 0.5 wt% to 50 wt% of at least one surfactant selected from the group consisting of anionic surfactants, cationic surfactants, nonionic surfactants, amphoteric surfactants, and mixtures thereof; and
   (d) from 0.5 wt% to 98.5 wt% of at least one organic solvent having a Partition Coefficient (LogP) ranging from -1 to 3.5, wherein said organic solvent is selected from the group consisting of glycol ethers, glycol ether esters, and mixtures thereof,
   wherein the weight ratio of said at least one organic solvent over said at least one surfactant is greater than 1, wherein said composition has a moisture content of less than 3 wt%.

2. The cleaning composition of claim 1, wherein the first, higher melting temperature of the first PCM is from 15°C to 50°C.

3. The cleaning composition of claim 1, wherein the first PCM is an ester formed by esterification reaction between a \( \text{C}_{14}-\text{C}_{8} \) carboxylic acid and a \( \text{C}_{1}-\text{C}_{4} \) alcohol.

4. The cleaning composition of claim 1, wherein the first PCM is butyl stearate.

5. The cleaning composition of claim 1, wherein the first PCM is a fatty acid mixture containing two or more different \( \text{C}_{10}-\text{C}_{14} \) fatty acids.
6. The cleaning composition of claim 1, wherein the first PCM is a mixture of lauric acid and capric acid.

7. The cleaning composition according to any one of claims 1 to 6, wherein the second, lower melting temperature of the second PCM is from -15°C to 20°C.

8. The cleaning composition according to any one of claims 1 to 6, wherein the second PCM is selected from C\textsubscript{10}-C\textsubscript{20} alkanes and mixtures thereof.

9. The cleaning composition according to any one of claims 1 to 6, wherein the second PCM is selected from the group consisting of dodecane, tetradecane, pentadecane, and mixtures thereof.

10. The cleaning composition according to any one of claims 1 to 6, wherein the second PCM is a mixture of dodecane, tetradecane, and pentadecane.

11. The cleaning composition according to any one of claims 1 to 10, wherein the at least one surfactant is a nonionic surfactant selected from the group consisting of C\textsubscript{10}-C\textsubscript{20} alkyl alkoxylates (AE) having a weight average degree of alkoxylation ranging from 0.1 to 10, and combinations thereof.

12. The cleaning composition of claim 11, further comprising an anionic surfactant.

13. The cleaning composition according to any one of claims 1 to 12, wherein the at least one organic solvent is selected from the group consisting of ethylene glycol propyl ether, ethylene glycol n-butyl ether, ethylene glycol hexyl ether, diethylene glycol methyl ether, diethylene glycol ethyl ether, diethylene glycol n-butyl ether, diethylene glycol hexyl ether, triethylene glycol methyl ether, triethylene glycol ethyl ether, triethylene glycol n-butyl ether, propylene glycol methyl ether, dipropylene glycol methyl ether, tripropylene glycol methyl ether, dipropylene glycol dimethyl ether, propylene glycol n-propyl ether, dipropylene glycol n-propyl ether, propylene glycol n-butyl ether, dipropylene glycol n-butyl ether, tripropylene glycol n-butyl ether, ethylene glycol phenyl ether, propylene glycol phenyl ether, ethylene glycol n-butyl ether acetate, diethylene glycol n-butyl ether acetate, propylene glycol methyl ether acetate, propylene glycol diacetate, and mixtures thereof.
14. The cleaning composition according to any one of claims 1 to 12, wherein the at least one organic solvent is dipropylene glycol n-butyl ether.

15. The cleaning composition according to any one of claims 1 to 14, characterized by a pH value of at least 7.

16. The cleaning composition according to any one of claims 1 to 15, which is adapted for direct application to fabrics or hard surfaces.

17. The cleaning composition of claim 16, which is selected from the group consisting of a pre-laundering treatment composition for fabrics, a machine-wash dish detergent composition, a hand-wash dish detergent composition, a kitchen counter cleaning composition, a floor cleaning composition, a bathroom or toilet bowl cleaning composition, an automotive care composition, and combinations thereof.

18. A cleaning composition comprising:
   (a) from 0.5 wt% to 10 wt%, preferably from 1 wt% to 7 wt%, and more preferably from 3 wt% to 5 wt%, of butyl stearate;
   (b) from 0.5 wt% to 10 wt%, preferably from 1 wt% to 7 wt%, and more preferably from 3 wt% to 5 wt%, of tetradecane;
   (c) from 0.5 wt% to 10 wt%, preferably from 1 wt% to 7 wt%, and more preferably from 3 wt% to 5 wt%, of pentadecane;
   (d) from 0.5 wt% to 10 wt%, preferably from 1 wt% to 7 wt%, and more preferably from 3 wt% to 5 wt%, of dodecane;
   (e) from 5 wt% to 50 wt%, preferably from 10 wt% to 30 wt%, and more preferably from 15 wt% to 20 wt%, of a nonionic surfactant that is a C_{12-15} alkyl ethoxylated alcohol having a weight average degree of ethoxylation ranging from 5 to 10; and
   (f) from 5 wt% to 50 wt%, preferably from 10 wt% to 30 wt%, and more preferably from 15 wt% to 20 wt%, of an anionic surfactant that is a C_{10-20} linear alkylbenzene sulphonate (LAS);
   (g) from 20 wt% to 90 wt%, preferably from 30 wt% to 70 wt%, and more preferably from 40 wt% to 60 wt%, of an organic solvent that is dipropylene glycol n-butyl ether,
wherein the weight ratio of \((g)/(e)+(f)\) is greater than 1, wherein said composition has a moisture content of less than 3 wt%.

19. A cleaning composition comprising:
(a) from 0.1 wt% to 5 wt%, preferably from 0.5 wt% to 4 wt%, and more preferably from 1.5 wt% to 2 wt%, of capric acid;
(b) from 0.1 wt% to 5 wt%, preferably from 1 wt% to 4 wt%, and more preferably from 2 wt% to 2.5 wt% of lauric acid;
(c) from 0.5 wt% to 10 wt%, preferably from 1 wt% to 7 wt%, and more preferably from 3 wt% to 5 wt%, of tetradecane;
(d) from 0.5 wt% to 10 wt%, preferably from 1 wt% to 7 wt%, and more preferably from 3 wt% to 5 wt%, of pentadecane;
(e) from 0.5 wt% to 10 wt%, preferably from 1 wt% to 7 wt%, and more preferably from 3 wt% to 5 wt%, of dodecane;
(f) from 5 wt% to 50 wt%, preferably from 10 wt% to 30 wt%, and more preferably from 15 wt% to 20 wt%, of a nonionic surfactant that is a \( \text{C}_{12-14} \) alkyl ethoxylated alcohol having a weight average degree of ethoxylation ranging from 5 to 10; and
(g) from 5 wt% to 50 wt%, preferably from 10 wt% to 30 wt%, and more preferably from 15 wt% to 20 wt%, of an anionic surfactant that is a \( \text{C}_{10-20} \) linear alkylbenzene sulphonate (LAS);
(h) from 20 wt% to 90 wt%, preferably from 30 wt% to 70 wt%, and more preferably from 40 wt% to 60 wt%, of an organic solvent that is dipropylene glycol n-butyl ether,

wherein the weight ratio of \((h)/(f)+(g)\) is greater than 1, wherein said composition has a moisture content of less than 3 wt%.
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"A" document member of the same patent family

Date of the actual completion of the international search: 16 March 2016

Date of mailing of the international search report: 29/03/2016

Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016

Authorized officer: Gaul t, Natha l i e
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