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(54) Abstract Title: **Cleaning composition and method**

(57) A cleaning composition for use in a method of cleaning an inanimate article employing a cleaning composition and which is aided by ultrasonic energy. The cleaning composition is a thin liquid comprising 2.2 - 12% of an amine oxide surfactant, one or more additional components selected from the group consisting of a complexing agent, a bleaching agent, an additional surfactant and a base; and a diluent, preferably water.

A method of cleaning articles is also claimed.

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CLEANING COMPOSITION AND METHOD

The present invention relates to ultrasonic cleaning, particularly to an ultrasonic cleaning method employing a cleaning composition, and to a cleaning composition for use in such an ultrasonic cleaning method.

There are various known methods and cleaning products which are employed for cleaning inanimate articles such as, for example, carpets, curtains and soft furnishings, as well as articles of clothing. Methods for removing soiling on a regular basis include laundering, vacuuming and wiping with a damp cloth. The suitability of known cleaning methods for cleaning a particular article depends of course on the nature of the article to be cleaned.

If a part of an article becomes heavily soiled or stained then a cleaning method may be employed wherein a special treatment is applied to the affected part. This may comprise a stand-alone treatment or a pre-treatment employed prior to employing a regular cleaning method. For example, if part of an article of clothing becomes stained a stain removal product may be applied to the stained part as a pre-treatment. The stain removal product may be applied by being rubbed into the clothing. An absorbent cloth may then be applied to the treated part to draw the stain out of the clothing. After the pre-treatment the clothing may then be washed in a regular manner.

Known cleaning methods can be time-consuming and labour intensive and may not always be effective in removing

soiling and in particular heavy soiling or stains from an article being cleaned.

Attempts have been made to address such problems associated with known cleaning methods by employing an ultrasonic device to apply ultrasonic energy to an article to be cleaned. Several methods of cleaning employing ultrasonic energy are known and various cleaning compositions and ultrasonic devices have been proposed and developed.

Several ultrasonic devices have been disclosed by Kao Corporation of Japan in various patent applications including: JP2002-186921, JP2002-166238, JP2001-310165, JP2001-113087, EP1149637 and EP1195460. However, many known cleaning compositions show little improvement in their effectiveness when employed together with ultrasonic energy. Indeed some even exhibit a decrease in performance. Accordingly, there exists the need for an improved cleaning composition which exhibits good removal of soiling when employed in a cleaning method together with ultrasonic energy.

According to a first aspect of the present invention there is provided a cleaning composition for use in a method of cleaning an inanimate article employing ultrasonic energy, wherein the cleaning composition comprises:

an amine oxide surfactant in an amount of between 2.2 and 12% by weight of the total weight of the cleaning composition;

one or more additional components selected from the group consisting of a complexing agent, a bleaching agent, an additional surfactant and a base; and

a diluent.

Amine oxide surfactants may be supplied in a formulation with other components. Percentage values given herein for the amine oxide surfactant refer to the amine oxide surfactant itself.

Preferably, the cleaning composition has a viscosity of at least 1 centipoise (cp), preferably at least 3 centipoises. Preferably, the composition has a viscosity of less than 25 centipoise, still more preferably less than 20 centipoise, more preferably less than 15 centipoise, and most preferably less than 10 centipoise. Suitably, for this definition the viscosity is measured with a commercially available Brookfield DV II and viscometer using spindle LV3 at a temperature of 22°C.

Suitably, the cleaning composition has a viscosity which may allow for ready application of the composition to an article to be cleaned. Suitably, the cleaning composition has a viscosity which may provide good soil removal in a cleaning method employing ultrasonic energy. Suitably, the cleaning composition has a viscosity which may allow the composition to be readily removed from the article following the application of ultrasonic energy. The cleaning composition may have a viscosity which allows it to soak into the article to be cleaned. Preferably, the cleaning composition soaks into the article to be cleaned before and/or during the application of ultrasound.

Preferably, following the application of ultrasound the cleaning composition can then be removed, partially or, preferably substantially wholly from the article.

Suitably, the viscosity of the cleaning composition is selected to be of an above defined value such that it allows for effective transmission of ultrasonic energy to the article to be cleaned.

Preferably, the cleaning composition comprises no more than 11% by weight of an amine oxide surfactant, more preferably no more than 10%, more preferably no more than 9%, more preferably no more than 8%, more preferably no more than 7%, more preferably no more than 6%, more preferably no more than 5%, for example, no more than 4%.

Preferably, the cleaning composition comprises at least 2.3% by weight of an amine oxide surfactant, more preferably at least 2.4%, more preferably at least 2.5%, more preferably at least 2.6%, more preferably at least 2.7%, more preferably at least 2.8%, for example, at least 2.9%.

Preferably, the composition comprises between 2.2 and 11% by weight (active component) of an amine oxide surfactant. Preferably, the cleaning composition comprises between 2.5 and 10% by weight (active component) of an amine oxide surfactant, more preferably between 2.5 and 6%, more preferably between 2.8 and 5% by weight; for example between 2.8 and 3.2%.

The amine oxide surfactant suitably has the formula:

$R^1R^2R^3N^+-O^-$

wherein R^1 is suitably an alkyl group containing 5-25, preferably 8-20, preferably 10-18, more preferably 11-13, for example 12, carbon atoms and wherein R^2 and R^3 are, each, independently, suitably a hydroxyalkyl or, preferably, an alkyl group, in each case containing 1 to 6 and preferably 1 to 2 carbon atoms, most preferably 1 carbon atom. Preferably, R^1 comprises a linear alkyl group.

Preferred amine oxide surfactants in particular include C_{10}-C_{18} alkyl dimethyl amine oxides, most preferred are C_{11}-C_{13} alkyl dimethyl amine oxide, for example a C_{12} alkyl dimethyl amine oxides. Preferably, the amine oxide comprises NN-dimethyl-N-dodecylamine N-oxide.

The cleaning composition may comprise a complexing agent.

The cleaning composition may comprise a bleaching agent, preferably a bleaching agent of the active oxygen type, for example hydrogen peroxide.

The cleaning composition may comprise a base.

Preferably, the diluent comprises water.

Suitably, the cleaning composition comprises a complexing agent, bleaching agent and a base. The cleaning composition may comprise a complexing agent, bleaching agent and a base and preferably does not comprise any

surfactants in addition to the amine oxide surfactant(s).

Although embodiments of the cleaning composition could comprise enzyme(s) the cleaning composition preferably does not comprise any enzyme(s).

Although embodiments of the cleaning composition could comprise a bleach activator the cleaning composition preferably does not comprise any bleach activator(s).

The cleaning composition may suitably comprise an amine oxide surfactant, complexing agent, bleaching agent, base and diluent. A suitable cleaning composition consists essentially of these components.

A suitable cleaning composition may consist of at least 70% by weight of the total cleaning composition weight of an amine oxide surfactant and diluent.

A suitable cleaning composition may consist of at least 80% by weight of the total cleaning composition weight of an amine oxide surfactant, diluent and one or more components selected from the group consisting of a complexing agent, a bleaching agent, an additional surfactant and a base.

Preferably, a suitable cleaning composition may consist of at least 90%, more preferably at least 95%, for example at least 98% by weight of the total cleaning composition weight of an amine oxide surfactant, diluent and one or more components selected from the group consisting of a complexing agent, a bleaching agent, an additional surfactant and a base.

A suitable cleaning composition may consist of at least 90% by weight of the total cleaning composition weight of an amine oxide surfactant, diluent and base and the remainder of the cleaning composition weight may be made up by components consisting of a complexing agent and bleaching agent.

A suitable cleaning composition may consist of at least 80% by weight of the total cleaning composition weight of an amine oxide surfactant, diluent and base and the remainder of the cleaning composition weight may be made up by components consisting of a bleach activator and a percarbonate.

When a bleach activator is present it is suitably present in the cleaning composition may comprise a bleach activator in an amount of up to 7% by weight (active component) of the total weight of the cleaning composition; preferably up to 6%, and more preferably in the range 3 to 5%. Suitable bleach activators may include sodium nonanoyloxybenzenesulphonate (NOBS or SNOBS), and tetraacetylethylenediamine (TAED).

The cleaning composition may comprise a surfactant, additional to the amine oxide. Suitably, the additional surfactant comprises a non-ionic surfactant. For example it may comprise methoxylated fatty alcohol, for example one of the LUTENSOL products from BASF, Germany.

Suitably, the cleaning composition has a pH of between 6 and 12. Preferably, the cleaning composition has a pH of between 7 and 11, more preferably between 8 and 11, more

preferably between 8.5 and 10.5, more preferably of between 8.5 and 10 and more preferably of between 9 and 10. For example the cleaning composition may have a pH of 9.5, alternatively it may have a pH of 9.

Preferably, the base when present comprises an alkali metal (preferably sodium) hydroxide or salt. Most preferably the base comprises one of more of sodium bicarbonate, sodium carbonate and sodium hydroxide.

When the cleaning composition comprises a base it is preferably present in an amount of up to 10% by weight (active component), more preferably up to 5% by weight, of the total weight of the cleaning composition. Preferably, the cleaning composition comprises a base in an amount necessary to adjust the pH of the composition to be within a preferred pH range. Preferably, the cleaning composition comprises up to 3.5% by weight (active component) of a base, more preferably between 0.01 and 2%, more preferably between 0.01 and 1%. Preferably, the cleaning composition comprises between 0.02 and 0.5% by weight of the base, more preferably between 0.04 and 0.30%, more preferably between 0.06 and 0.20%, for example between 0.07 and 0.17%.

Preferably, the cleaning composition comprises a complexing agent in an amount of up to 5% by weight (active component) of the total weight of the cleaning composition, more preferably up to 4%, more preferably between 0.005 and 3%. Preferably, the composition comprises between 0.005 and 2% by weight (active component) of complexing agent, more preferably between

0.01 and 1%, more preferably between 0.01 and 0.5%, for example between 0.01 and 0.1%.

Preferably, the complexing agent comprises a chelating agent. Preferably, the complexing agent comprises a phosphorous containing compound. The complexing agent may comprise a phosphonate compound such as that of formula (1) described in EP 0009839. Preferably the complexing agent comprises sodium salt of diethylenetriamine pentamethylene phosphonic acid. The complexing agent may further comprise sodium salt of diethylenetriamine trimethylene phosphonic acid and may further comprise sodium salt of diethylene triamine tetramethylenephosphonic acid and sodium salt of diethylenetriamine tetramethylenephosphonic acid. Preferably, at least 70% by weight, more preferably at least 80% by weight of the complexing agent comprises sodium salt of diethylenetriamine pentamethylene phosphonic acid.

Preferably, the composition comprises a bleaching agent in an amount of up to 10% by weight (active component) of the total weight of the cleaning composition. Preferably, the composition comprises between 1 and 7% by weight (active component) of bleaching agent, more preferably between 5 and 7%, for example around 6%. Preferably, the bleaching agent comprises hydrogen peroxide.

The cleaning composition may further comprise additional cleaning agents. Suitable additional cleaning agents may include agents selected from the group comprising; builders, surfactants, enzymes, colorants, perfume, lime soap dispersants, polymeric dye transfer inhibiting

agents, antibacterial agent, crystal growth inhibitors, anti-tarnishing agents, anti-microbial agents, anti-oxidants, anti-redeposition agents, soil release polymers, electrolytes, buffering agents, thickeners, abrasives, divalent metal ions, metal ion salts, enzyme stablizers, corrosion inhibitors, diamines, suds stablizing polymers, process aids, fabric softening agents, optical brighteners, hydrotropes and mixtures thereof.

Suitably, the cleaning composition is arranged to be suitable for treating food stains, ink stains and personal soiling stains. For example the cleaning composition may be arranged to be effective in treating stains caused by one or more of food, red wine, fruit juice, turmeric, tea, coffee, grass, ink, sweat, sebum, vegetable or mineral grease and vegetable or mineral oil.

Suitably, the cleaning composition is arranged to be employed with ultrasonic energy having a frequency of at least 10 kHz, preferably at least 20 kHz. Preferably, the ultrasonic energy has a frequency of up to 2MHz, more preferably up to 100 kHz. Preferably, the cleaning composition is arranged to be employed with ultrasonic energy which has a frequency of between 20 and 60 kHz, for example 50 kHz.

Suitably, the cleaning composition is arranged to be employed to clean soft articles and/or soft surfaces of articles, where the whole article is not soft; especially textile surfaces. Suitably, the cleaning composition may be employed to clean household textiles, for example carpets and/or soft furnishings and/or curtains and/or bedding. Alternatively, the cleaning composition may be

employed to clean articles of clothing. Preferably, when employed to clean articles of clothing the cleaning composition is employed as a pre-treatment prior to a further cleaning process.

Suitably, the cleaning composition is arranged to be applied onto a surface of an article to be cleaned. Alternatively, or in addition, the cleaning composition may be such that an article to be cleaned can be immersed in a volume of the cleaning composition.

Suitably, the cleaning composition is arranged such that it can be removed from an article after ultrasonic energy has been applied to an article in a cleaning operation. Suitably, the composition is arranged such that it can be washed and/or wiped off the article.

According to a second aspect of the present invention, there is provided a method of cleaning an inanimate article, wherein the method employs an ultrasonic energy source comprising an ultrasonic device arranged to apply ultrasonic energy to said article and a cleaning composition comprising an amine oxide surfactant in an amount between 2.2% and 12% by weight of the total weight of the cleaning composition.

Preferably, the cleaning composition comprises a cleaning composition according to the first aspect.

Preferably, the ultrasonic device comprises a hand held ultrasonic transmitter. Preferably, the ultrasonic device comprises a portable device. Preferably, the ultrasonic

device comprises a transmitter and power source in a single unit which may be held by a user in one hand.

Preferably, the ultrasonic device is of the type having a battery and ultrasonic generator in a main body part which is grasped by a user, and which has a tapering part leading to a contact head, of chisel-like shape, preferably 0.5-5 cm long, more preferably 1-3 cm long, by 0.2-4 mm wide, more preferably 1-3 mm wide. Such a device is available from Kao Corporation.

Suitably, ultrasonic energy is applied to an article to be cleaned from an ultrasonic device having a transmitting head which is arranged to make contact with the soiled area of the article.

Suitably, the ultrasonic device emits waves having a frequency as described above.

Preferably, the ultrasonic waves are of such a frequency that they provide a beneficial cleaning effect in combination with the cleaning composition but are not of such an energy that in normal use they would cause damage to a user, for example skin damage or damage to sub-epidermal cells. The method according to the second aspect may thus be suitable to be performed by an unskilled operator, for example a home occupier in their home. Alternatively, or additionally, the cleaning method according to the present invention may be performed by a professional cleaner.

Suitably, the method comprises cleaning soft articles and/or soft surfaces of articles, where the whole article

is not soft. Suitably, the method may comprise cleaning household textiles, for example carpets and/or soft furnishings and/or curtains and/or bedding. Alternatively, the method may comprise cleaning articles of clothing. Preferably, when the method comprises cleaning articles of clothing, said method comprises a pre-treatment process employed prior to a further cleaning process.

The cleaning method according to the present invention may be suitable for treating a small area of an article which has become heavily soiled, for example an article which has become stained. The cleaning method may be suitable for treating a variety of stains, for example a variety of food stains. The cleaning method according to the present invention may be suitable for cleaning the whole of an article which is lightly soiled. The cleaning method of the present invention may also be suitable for cleaning a whole article, the whole of which has become heavily soiled.

Suitably, the method comprises applying the cleaning composition to a surface of an article to be cleaned. Suitably, the article is dry. Suitably, once the cleaning composition has been applied to the article, ultrasonic energy is then applied to the treated area of the article without any appreciable time delay. For example, ultrasonic energy may be applied to the article within a minute of the cleaning composition being applied to the article. Alternatively, the article having the cleaning composition applied thereto may be left to stand before ultrasonic energy is applied thereto.

Preferably, ultrasonic energy is applied to the article having the cleaning composition applied thereto for at least 5 seconds. Preferably, ultrasonic energy is applied to the article for between 10 seconds and 5 minutes, more preferably for between 10 seconds and 3 minutes, for example between 20 seconds and 2 minutes, more preferably between 20 seconds and 70 seconds, for example for around 30 seconds.

Suitably, the cleaning composition soaks into the article to be cleaned before and/or during the application of ultrasonic energy.

Preferably, the treated article is left to stand following the application of ultrasonic energy. Preferably, the article is left to stand for at least 30 seconds, more preferably for at least 1 minute. Preferably, the article is left to stand for between 1 minute and 6 minutes, more preferably between 2 minutes and 5 minutes, more preferably between 4 minutes and 5 minutes, for example for around 4.5 minutes.

Suitably, after the application of ultrasonic energy and preferably after the article has been left to stand, the cleaning composition is removed. For example, the cleaning composition may be wiped off using an absorbent cloth which may be a damp cloth.

Alternatively, the article to be cleaned may be immersed in a volume of cleaning composition. Preferably, once immersed in cleaning composition such that a soiled area of the article is in contact with said composition, ultrasonic energy is applied to the article. Suitably,

the ultrasonic energy is applied for at least 5 seconds, more preferably for between 10 seconds and 5 minutes, more preferably for between 10 seconds and 3 minutes, for example between 20 seconds and 2 minutes, more preferably between 20 seconds and 70 seconds, for example for around 30 seconds.

Preferably, following the application of ultrasonic energy, the treated article is removed from the volume of cleaning composition and any residual cleaning composition removed therefrom.

Suitably, when an article is treated according to either of the above described methods the cleaning composition is removed by washing with water. The article may be washed in cold water. The article may be washed by being placed under a flow of water. For example, the article may be placed under a running tap. Alternatively, the article may be washed in a washing machine.

After the washing step the article may be dried in a tumble dryer. Alternatively, the article may be left to dry naturally.

According to a third aspect of the present invention there is provided a packaged product comprising a container comprising a cleaning composition according to the first aspect, said container being adapted to allow said cleaning composition to be applied to an article to be cleaned.

Suitably, the container comprises a ball roller. Alternatively, the container may be arranged to provide a

spray of cleaning composition. The container may thus comprise a trigger spray or an aerosol.

Suitably, the packaged product is arranged to be employed in a method according to the second aspect.

According to a fourth aspect of the present invention there is provided a kit of parts comprising a packaged product according to the third aspect and a device arranged to emit ultrasonic energy.

Specific embodiments of the present invention will now be described by way of example.

Experimental Method

Fabric Preparation

Stained fabrics were prepared to test cleaning compositions of the invention comprising an amine oxide surfactant with the method of the invention. Such fabrics were also used to test comparative examples. The same procedures, outlined below, were employed for each.

Fabric Stripping

A fabric was stripped by three consecutive washes, as follows.

Wash Number 1 - the fabric to be stripped (max weight 6 pounds(2.7 kg)) was added to a washer and the machine set to hot water (90°C) wash/cold water rinse, large load, normal cycle. When the water level was full one scoop

(approx 90g) of washing powder (TIDE - trade mark) and 1 cup (240 ml) of household chlorine bleach (1% sodium hypochlorite) was added. The fabric was washed for 12 minutes.

Wash Number 2 - the machine was set to hot water wash/cold water rinse, large load, normal cycle. When the water level was full one scoop of washing powder (TIDE) was added. The fabric was washed for 12 minutes.

Wash Number 3 - The machine was set to hot water wash/cold water rinse, large load, normal cycle and the fabric washed for 12 minutes with no detergent.

The fabric was dried on a dried normal drying cycle until dry.

Stained Fabric preparation:

A variety of stains were produced on the stripped fabric according to the following procedures.

Grass

Prestained test swatches supplied by Westlairds Ltd.

Coffee

Prestained test swatches supplied by Westlairds Ltd.

Food Grease 500g of corn oil was fried with 150g of potatoes for 5 mins. The grease was allowed to cool and 0.1% sudan red dye

added. 10 drops of food grease were pipetted onto a stripped fabric and allowed to dry overnight before use.

Stain Removal Tests

Stained fabrics were treated either with a cleaning composition of the invention comprising an amine oxide surfactant together with ultrasonic energy or alternatively with a comparative cleaning composition and/or without using ultrasonic energy. In each case one of the following test methods was employed.

Trough ultrasonic test method

A trough having a diameter of around 80-90 mm and a depth such that it could hold 40 ml of solution was employed. A stained fabric was placed in the trough and the trough was charged with 40ml of cleaning composition. Ultrasonic energy was applied using an ultrasonic device as described above for 30 seconds, such that the device head was immersed in the composition and made contact with the stain and was moved in a gentle stroking motion with ultrasonic energy being applied through the composition. The fabric was removed from the trough and washed in cold tap water. The fabric was then dried in a tumble dryer.

Trough non-ultrasonic test method:

The procedure of the trough ultrasonic test method was repeated but with the ultrasonic device turned off.

"Dry" ultrasonic test method

2g of cleaning composition was pipetted onto the stain and ultrasonic energy applied using an ultrasonic device for 30 seconds by direct contact of the device head with the stain in a gentle stroking motion. The fabric was left for another 4.5 min before washing in cold tap water and drying in a tumble drier.

"Dry" non-ultrasonic test method:

2g of cleaning composition was applied to the fabric and the stain was rubbed for 30 seconds. The fabric was left for 4½ min before washing in cold tap water. The fabric was then dried in a tumble drier.

Stain removal assessment

Stain removal was assessed according to one of two methods.

Stain Removal Index Calculation

The reflectance of the treated stained area, and of an unstained area was measured with a Minota CM-3700D reflectometer. The stain removal index (SRI) for each test area was calculated using the following formula:

$$SRI = 100 - [(L_c^* - L_w^*)^2 + (a_c^* - a_w^*)^2 + (b_c^* - b_w^*)^2]^{1/2}$$

Where,

L* = Reflectance,
a* = redness/greenness,
b* = yellowness/blueness,
c = unstained fabric background
w = test area where treatment was applied

Change in reflectance calculation.

The reflectance of a stained area was measured before and after treatment using a Minolta CM-3700D reflectometer and the difference in reflectance calculated.

Examples

Cleaning compositions were prepared by combining an amine oxide surfactant solution with additional components and these were tested with ultrasound according to the above described procedures as detailed below. Comparative tests were performed using compositions containing an amine oxide surfactant within the range of the invention without ultrasound and also using other cleaning compositions both with and without ultrasound.

Example 1

A cleaning composition having an amine oxide surfactant present in an amount of 5% by weight was prepared according to the following formulation:

16.7% by weight of AMMONYX LO-E (Trade Mark) available from STEPAN UK, being a surfactant solution comprising 30% by weight of the amine oxide N,N-dimethyl-N-dodecylamine N-oxide; and

83.3% by weight of deionised water to make up the balance.

In duplicate tests a fabric having a food grease stain was treated with the composition according to the trough ultrasonic test method and the SRI was measured. The result is shown in Table 1 below.

Example 2

A cleaning composition having an amine oxide surfactant present in an amount of 10% by weight was prepared according to the following formulation:

33% by weight of AMMONYX LO-E; and

77% by weight of deionised water.

In duplicate tests a fabric having a food grease stain was treated with the composition according to the trough ultrasonic test method described in Example 1, and the SRI measured. The result is shown in Table 1 below.

Comparative Example A

As a comparative example a cleaning composition having an amine oxide surfactant present in am amount of 1% by weight was prepared according to the following formulation:

3.3% by weight of AMMONYX LO-E; and

96.7% by weight of deionised water.

In duplicate tests a fabric having a food grease stain was treated with the composition according to the trough ultrasonic test method described in Example 1, and the SRI measured. The result is shown in Table 1 below.

Comparative Example B

As a comparative example, AMMONYX LO-E was used as a cleaning composition as supplied. The amine oxide surfactant level was thus 30%.

In duplicate tests a fabric having a food grease stain was treated with the composition according to the trough ultrasonic test method described in Example 1, and the SRI measured. The result is shown in Table 1 below.

TABLE 1

Example	Amine oxide% by wt	Stain	Test	SRI (Average)
1	5	Grease	Ultrasonic trough	93.3
2	10	Grease	Ultrasonic trough	94.4
A	1	Grease	Ultrasonic trough	92.1
B	30	Grease	Ultrasonic trough	87.3

As shown in Table 1 the use of a composition comprising an amine oxide surfactant within the range of the invention (2.2 to 12% by weight) gives a beneficial increase in the SRI in comparison to compositions comprising lower and in particular higher levels of amine oxide surfactant. Without wishing to be bound by theory it is believed this benefit may be due to the viscosity of the cleaning compositions being within a range which allows the composition to respond well when employed with ultrasonic energy.

Example 3

A cleaning composition having an amine oxide surfactant present in an amount of 5% by weight was prepared according to the formulation of Example 1:

16.7% by weight of AMMONYX LO-E; and

83.3% by weight of deionised water.

In duplicate tests a fabric having a food grease stain was treated with the composition according to the trough ultrasonic test method described in Example 1, and the SRI measured. The result is shown in Table 2 below.

Comparative Example C

As a comparative example the composition of Example 3 was employed without ultrasound. In duplicate tests a fabric having a food grease stain was treated with the composition according to the trough non-ultrasonic test

method described in Example 1, and the SRI measured. The result is shown in Table 2 below.

Comparative Example D

As a comparative example deionised water was employed as a cleaning composition with ultrasound. In duplicate tests a fabric having a food grease stain was treated with the composition according to the trough ultrasonic test method described in Example 1, and the SRI measured. The result is shown in Table 2 below.

Comparative Example E

As a comparative example deionised water was employed as a cleaning composition without ultrasound. In duplicate tests a fabric having a food grease stain was treated with the composition according to the trough non-ultrasonic test method described in Example 1, and the SRI measured. The result is shown in Table 2 below.

Table 2

Example	Amine oxide % by wt	Stain	Test	SRI (Average)
3	5	Grease	Ultrasonic trough	94.1
C	5	Grease	Non-ultrasonic trough	80.0
D	0	Grease	Ultrasonic trough	87.7
E	0	Grease	Non-ultrasonic trough	83.2

As can readily be seen, the use of a composition comprising an amine oxide without ultrasound was less effective than water alone without ultrasonic energy. However the composition comprising the amine oxide surfactant was much more effective at removing staining than water alone when used in combination with ultrasonic energy. A beneficial effect was clearly obtained from the combination of ultrasound and a cleaning composition comprising an amine oxide surfactant. Without wishing to be bound by theory it is believed that at the concentrations of amine oxide surfactant employed in the present invention the cleaning composition and the ultrasonic energy each enhance the effectiveness of the other.

Example 4

A cleaning composition having an amine oxide surfactant present in an amount of 3% by weight was prepared according to the following formulation:

10% by weight of AMMONYX LO-E; and

90% by weight of deionised water.

In duplicate tests a fabric having a food grease stain was treated with the composition according to the dry ultrasonic test method described in Example 1, and the SRI measured. The result is shown in Table 3 below.

Comparative Example F

As a comparative example the composition of Example 4 was employed without ultrasound. In duplicate tests a fabric having a food grease stain was treated with the composition according to the dry non-ultrasonic test method described in Example 1, and the SRI measured. The result is shown in Table 3 below).

Example 5

A cleaning composition having an amine oxide surfactant present in an amount of 3% by weight was prepared according to the following formulation:

10% by weight of AMMONYX LO-E;

4% by weight of LUTENSOL (Trade Mark), available from BASF - a non-ionic surfactant comprising an ethoxylated fatty alcohol.

86% by weight of deionised water.

In duplicate tests a fabric having a food grease stain was treated with the composition according to the dry ultrasonic test method described in Example 1, and the SRI measured. The result is shown in Table 3 below.

Comparative Example G

As a comparative example the composition of Example 5 was employed without ultrasound. In duplicate tests a fabric

having a food grease stain was treated with the composition according to the dry non-ultrasonic test method described in Example 1, and the SRI measured. The result is shown in Table 3 below.

Example 6

A cleaning composition having an amine oxide surfactant present in an amount of 3% by weight was prepared according to the following formulation:

10% by weight of AMMONYX LO-E;

1% by weight of LUTENSOL; and

89% by weight of deionised water.

In duplicate tests a fabric having a food grease stain was treated with the composition according to the dry ultrasonic test method described in Example 1, and the SRI measured. The result is shown in Table 3 below.

Comparative Example H

As a comparative example the composition of Example 6 was employed without ultrasound. In duplicate tests a fabric having a food grease stain was treated with the composition according to the dry non-ultrasonic test method described in Example 1, and the SRI measured. The result is shown in Table 3 below.

Comparative Example I

As a comparative example (Example J below) a commercially available cleaning composition "SPRAY N' WASH Extra Strength" (Trade Mark) available from Reckitt Benkiser was employed without ultrasound. This cleaning composition comprises non-ionic surfactants and enzymes. In duplicate tests a fabric having a food grease stain was treated with the composition according to the dry non-ultrasonic test method described in Example 1, and the SRI measured. The result is shown in Table 3.

Table 3

Example	Amine oxide % by wt	% by weight Other surfactant	Stain	Test	SRI (Average)
4	3	0	Grease	Dry-Ultrasonic	92.9
F	3	0	Grease	Dry-Non-Ultrasonic	85.4
5	3	4	Grease	Dry-Ultrasonic	94.3
G	3	4	Grease	Dry-Non-ultrasonic	87.4
6	3	1	Grease	Dry-Ultrasonic	94.2
H	3	1	Grease	Dry-Non-Ultrasonic	87.4
I	0	not disclosed	Grease	Dry-Non-Ultrasonic	87.4

As can be seen, the cleaning compositions containing the amine oxide surfactant either with or without the additional non-ionic surfactant gave a far better SRI when used together with ultrasonic energy than that given by one of the most effective commercial products without ultrasonic energy. It can also be seen that the combination of the non-ionic surfactant with the amine oxide surfactant gives an enhanced cleaning effect with ultrasonic energy in comparison to the amine oxide surfactant alone. However, the improvement is less marked with ultrasonic energy than without and without wishing to be bound by theory it is believed it is the interaction between ultrasonic energy, the amine oxide surfactant and the stain which provides the major contribution to the SRI values observed for Examples 4 and 5.

Example 7

A cleaning composition having an amine oxide surfactant present in an amount of 3% by weight was prepared according to the following formulation:

10% by weight of AMMONYX LO-E;

6% by weight of hydrogen peroxide;

0.2% by weight of DEQUEST 2066 (Trade Mark) available from Solutia, a solution comprising sodium salt or diethylenetramine pentamethylenephosphonic acid as the major active component;

2.0 - 4.0% by weight of 1M NaOH as required to adjust the pH to 9; and

81.8 - 79.8% by weight of deionised water to make up the balance.

In triplicate tests a fabric having a coffee stain was treated with the composition according to the dry ultrasonic test method described in Example 1, and the change in reflectance measured. The result is shown in Table 4 below.

Comparative Example J

As a comparative example the composition of Example 7 was employed without ultrasound. In triplicate tests a fabric having a coffee stain was treated with the composition according to the dry non-ultrasonic test method described in Example 1, and the change in reflectance measured. The result is shown in Table 4 below.

Example 8

A cleaning composition having an amine oxide surfactant present in an amount of 3% by weight was prepared according to the following formulation:

10% by weight of AMMONYX LO-E;

6% by weight of hydrogen peroxide;

0.2% by weight of DEQUEST 2066;

2.0 - 4.0% by weight of 1M NaOH as required to adjust the pH to 9.5; and

81.8 - 79.8% by weight of deionised water to make up the balance.

In triplicate tests a fabric having a coffee stain was treated with the composition according to the dry ultrasonic test method described in Example 1, and the change in reflectance measured. The result is shown in Table 4 below.

Comparative Example K

As a comparative example the composition of Example 8 was employed without ultrasound. In triplicate tests a fabric having a coffee stain was treated with the composition according to the dry non-ultrasonic test method described in Example 1, and the change in reflectance measured. The result is shown in Table 4 below.

Comparative Example L

As a comparative example a commercially available cleaning composition KALIA OXY ACTION GEL (Trade Mark), Examples L and M below, available from Reckitt Benkiser was employed with and without ultrasound, examples L and M below. This cleaning composition is a fabric pre-treater and comprises around 6% by weight hydrogen peroxide at around pH4 and between 5 and 15% by weight non-ionic surfactants and between 5 and 15% by weight anionic surfactants. In triplicate tests a fabric having a coffee stain was treated with the composition according to the dry ultrasonic test method described in Example 1, and the

change in reflectance measured. The result is shown in Table 4 below.

Comparative Example M

As a comparative example the composition of Comparative Example L was employed without ultrasound. In triplicate tests a fabric having a coffee stain was treated with the composition according to the dry non-ultrasonic test method described in Example 1, and the change in reflectance measured. The result is shown in Table 4 below.

Table 4

Example	Amine oxide % by weight	pH	Stain	Test	Change in reflectance (Average)
7	3	9	Coffee	Dry-Ultrasonic	160.3
J	3	9	Coffee	Dry-Non-ultrasonic	151.3
8	3	9.5	Coffee	Dry-Ultrasonic	169.1
K	3	9.5	Coffee	Dry-Non-ultrasonic	163.7
L	0		Coffee	Dry-Ultrasonic	28.4
M	0		Coffee	Dry-Non-ultrasonic	68.2

As can be seen the cleaning compositions comprising the amine oxide surfactant are more effective under conditions of higher pH. Although the amine oxide surfactant containing compositions exhibit only a small improvement when employed with ultra sonic energy rather than without it will be observed that this is largely due to the fact they are very effective at treating coffee stains even without the use of ultrasonic energy. Most significantly, the compositions of the invention do not show a decrease in performance when used with ultrasound as was the case with the commercially available composition KALIA.

Example 9

A cleaning composition having an amine oxide surfactant present in an amount of 3% by weight was prepared according to the formulation of Example 7:

10% by weight of AMMONYX LO-E;

6% by weight of hydrogen peroxide;

0.2% by weight of DEQUEST 2066;

2.0 - 4.0% by weight of 1M NaOH as required to adjust the pH to 9; and

81.8 - 79.8% by weight of deionised water to make up the balance.

In triplicate tests a fabric having a grass stain was treated with the composition according to the dry

ultrasonic test method and the change in reflectance measured. The result is shown in Table 5 below.

Comparative Example N

As a comparative example the composition of Example 9 was employed without ultrasound. In triplicate tests a fabric having a grass stain was treated with the composition according to the dry non-ultrasonic test method described in Example 1, and the change in reflectance measured. The result is shown in Table 5 below.

Example 10

A cleaning composition having an amine oxide surfactant present in an amount of 3% by weight was prepared according to the formulation of Example 8:

10% by weight of AMMONYX LO-E;

6% by weight of hydrogen peroxide;

0.2% by weight of DEQUEST 2066;

2.0 - 4.0% by weight of 1M NaOH as required to adjust the pH to 9.5; and

81.8 - 79.8% by weight of deionised water to make up the balance.

In triplicate tests a fabric having a grass stain was treated with the composition according to the dry ultrasonic test method described in Example 1, and the

change in reflectance measured. The result is shown in Table 5 below.

Comparative Example O

As a comparative example the composition of Example 10 was employed without ultrasound. In triplicate tests a fabric having a grass stain was treated with the composition according to the dry non-ultrasonic test method described in Example 1, and the change in reflectance measured. The result is shown in Table 5 below.

Comparative Example P

As a comparative example a commercially available cleaning composition KALIA OXY ACTION GEL was employed with ultrasound. In triplicate tests a fabric having a grass stain was treated with the composition according to the dry ultrasonic test method described in Example 1, and the change in reflectance measured. The result is shown in Table 5 below.

Comparative Example Q

As a comparative example the composition of Comparative Example P was employed without ultrasound. In triplicate tests a fabric having a grass stain was treated with the composition according to the dry non-ultrasonic test method described in Example 1, and the change in reflectance measured. The result is shown in Table 5 below.

Table 5					
Example	Amine oxide % by weight	pH	Stain	Test	Change in reflectance (Average)
7	3	9	Grass	Dry-Ultrasonic	165.2
N	3	9	Grass	Dry-Non-ultrasonic	139.0
8	3	9.5	Grass	Dry-Ultrasonic	148.3
O	3	9.5	Grass	Dry-Non-ultrasonic	128.9
P	0		Grass	Dry-Ultrasonic	118.4
Q	0		Grass	Dry-Non-ultrasonic	110.3

As can be seen cleaning compositions comprising the amine oxide surfactant were more effective on grass stains at a lower pH. It will also be noted that there was a marked improvement at their effectiveness when employed with rather than without ultrasonic energy. In contrast KALIA showed little improvement when used together with ultrasonic energy.

It will be readily understood that the cleaning compositions and method of the present invention may give benefits in the removal of many types of soiling. The present invention may thus give efficient and effective cleaning of soiled articles.

CLAIMS

1. A cleaning composition for use in a method of cleaning an inanimate article employing ultrasonic energy, wherein the cleaning composition comprises:

an amine oxide surfactant in an amount of between 2.2 and 12% by weight of the total weight of the cleaning composition;

one or more additional components selected from the group consisting of a complexing agent, a bleaching agent, an additional surfactant and a base; and

a diluent.

2. A composition as claimed in claim 1, and having a viscosity at 22°C of at least 1 centipoise.

3. A composition as claimed in claim 1 or 2, and having a viscosity at 22°C of less than 25 centipoises.

4. A composition as claimed in any preceding claim, wherein the composition contains from 2.5-6% by weight of amine oxide surfactant.

5. A composition as claimed in any preceding claim, and containing a complexing agent.

6. A composition as claimed in any preceding claim, and containing a bleaching agent.

7. A composition as claimed in any preceding claim, and containing a base.

8. A composition as claimed in any preceding claim, of which at least 80% of the weight of the composition is supplied by an amine oxide surfactant, a complexing agent, an active oxygen bleaching agent, a base, and water.

9. A composition as claimed in any preceding claim, the pH of the composition being in the range 6 to 12.

10. A composition as claimed in claim 9, wherein the pH of the composition is in the range 8 and 11.

11. A method of cleaning an inanimate article, wherein the method employs an ultrasonic energy source arranged to apply ultrasonic energy to said article and a cleaning composition as claimed in any preceding claim.

12. A method as claimed in claim 11, wherein the ultrasonic energy source emits ultrasonic energy in the range 20-100 kHz.

13. A method as claimed in claim 12, wherein the inanimate article has a soft surface, for example a textile surface.

14. A packaged product, being a container of a cleaning composition according to any of claims 1 to 10, said container being adapted to allow said cleaning composition to be applied accurately to an article to be cleaned.

15. A kit of parts comprising a container containing a composition as claimed in any of claims 1 to 10, and an ultrasonic energy source.

16. A cleaning composition, or method of cleaning, or packaged product, or kit, in each case substantially as hereinbefore described with particular reference to the accompanying examples 1 to 9.

INVESTOR IN PEOPLE

Application No: GB 0321390.7 **Examiner:** Michael Conlon
Claims searched: 1-16 **Date of search:** 20 February 2004

Patents Act 1977 : Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance	
X	1-16	US2003084916 A1	GAALOUL paragraph 0070
X	1 4-16	WO2001/036118 A1	PROCTER & GAMBLE page 78 line 16 [no.5] and page 79 line 19 [nos.12 and 13]
X	1-16	WO2000/029540 A1	PROCTER & GAMBLE Ingredient 4 on page 71
X	1-16	WO2000/029535 A1	PROCTER & GAMBLE page 74 Composition 2
X	1-10	US2003050200 A	CHEN YEN-LANE Table 1 on page 4
X	1-10	US6107263 A	COLGATE PALMOLIVE Example 1

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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C5D

Worldwide search of patent documents classified in the following areas of the IPC[7]:

C11D

The following online and other databases have been used in the preparation of this search report :

Online: WPI EPODOC JAPIO