SOLID DETERGENT COMPOSITION

FIELD OF INVENTION

[0001] The invention disclosed herein relates, in general, to solid detergent compositions. More specifically, the present invention relates to solid detergent compositions that dissolve at a fast rate and can work in extreme temperature conditions.

BACKGROUND

[0002] Detergent compositions are widely used for household and industrial dishwashing, laundering clothing and general surface cleansing. However, almost all floor detergents are usually liquid detergents that are stored in bottles. These detergents are usually difficult to handle and store owing to their size and weight.

[0003] Further, the liquid detergents have limited shelf life, which reduces once the bottle has been uncapped. Therefore, solid detergent compositions are being developed as a substitute for the conventionally available liquid detergents.

[0004] However, for use of the solid detergent compositions, the detergent needs to be mixed with water or other aqueous mediums. Therefore, in order to provide effective cleaning services for such applications, the components of the solid detergent composition need to readily dissolve in the aqueous mediums under different conditions. However, fast dissolution rates over a range of temperature conditions have still not been achieved.

[0005] In light of the above discussion, there is a need for developing a solid detergent condition that provides fast dissolution rates at different temperature conditions and overcomes one or more of the drawbacks listed above.

SUMMARY

[0006] The instant exemplary embodiments of the present invention provide a fast dissolving solid detergent composition.

[0007] The exemplary embodiments of the present invention provide a solid detergent composition that dissolves efficiently even at a temperature of 0°C.

[0008] Some embodiments of the invention provide a solid detergent composition that includes a fatty alcohol polyoxythylene ether, sodium sulfate, sodium percarbonate, sodium silicate, a water softener like sodium carbonate or potassium carbonate, a sequestering agent like sodium polyacrylate or Ethylenediaminetetraacetic acid (EDTA), polyvinylpyrrolidone, an enzyme like protease or α-amylase, an alkyl sulfate, and an esculent perfume. Further, the solid detergent composition is characterized such that it may have a dissolution rate of at least 3g/minute in an aqueous solution at close to 0°C.

DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

[0009] Before describing the present invention in detail, it should be observed that the present invention utilizes components related to a detergent composition. Accordingly, the components have been represented where appropriate showing only specific details that are pertinent for an understanding of the present invention so as not to obscure the disclosure with details that will be readily apparent to those with ordinary skill in the art of having the benefit of the description herein.

[0010] While the specification concludes with the claims defining the features of the invention that are regarded as novel, it is believed that the invention will be better understood from a consideration of the following description in conjunction with the drawings, in which like reference numerals are carried forward.

[0011] As required, detailed embodiments of the present invention are disclosed herein; however, it is to be understood that the disclosed embodiments are merely exemplary of the invention, which can be embodied in various forms. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the present invention in virtually any appropriately detailed structure. Further, the terms and phrases used herein are not intended to be limiting but rather to provide an understandable description of the invention.

[0012] The terms “a” or “an”, as used herein, are defined as one or more than one. The term “another”, as used herein, is defined as at least a second or more. The terms “including” and/or “having” as used herein, are defined as comprising (i.e. open transition). The term “coupled” or “operatively coupled” as used herein, is defined as connected, although not necessarily directly, and not necessarily mechanically.

[0013] All numeric values are herein assumed to be modified by the term “about,” whether or not explicitly indicated. The term “about” generally refers to a range of numbers that one of skill in the art would consider equivalent to the recited value (i.e., having the same function or result). In many instances, the terms “about” may include numbers that are rounded to the nearest significant figure.

[0014] Weight percent, percent by weight, wt %, % by weight, and the like are synonyms that refer to the concentration of a substance as the weight of that substance divided by the weight of the composition and multiplied by 100. As used in this application, the term “wt. %” refers to the weight percent of the indicated component relative to the total weight of the solid detergent composition, unless indicated differently. The weight percentage of an individual component does not include any water supplied with that component, even if the component is supplied as an aqueous solution or in a liquid premix, unless otherwise specified.

[0015] A solid detergent composition according to the present invention is a fast-dissolving detergent. The solid detergent composition as disclosed herein dissolves quickly and completely upon contact with an aqueous solution into a solution, at operating temperatures of 0° C and above.

[0016] The solid detergent composition according to the present invention includes a variety of forms including, for example, solids, pellets, blocks, and tablets. However, it should be understood that the term “solid” refers to the state of the detergent composition under the expected conditions of storage and use of the solid detergent composition.

[0017] The solid detergent composition enables soil removal and can include components that provide soil removal properties when dispersed or dissolved in an aqueous solution and applied to a substrate for removal of soil from the substrate. The solid detergent composition usually includes a fatty alcohol polyoxythylene ether, sodium sulfate, sodium percarbonate,

and sodium silicate. Further, the solid detergent composition also includes a water softener like sodium carbonate or potassium carbonate, a sequestering agent like sodium polyacrylate or Ethylenediaminetetraacetic acid (EDTA), polyvinylpyrrolidone, and an enzyme like protease or α-amylase. In some embodiments, the solid detergent composition can also include an alkyl sulfate and an esculent perfume.

[0018] The solid detergent composition includes fatty alcohol polyoxythylene ether. The fatty alcohol polyoxythylene ether acts as a non-ionic surfactant that lowers surface tension of a liquid and enabling easy cleaning of chosen surfaces by allowing better penetration of the detergent solution into a substrate soil that needs to be cleaned.

[0019] The fatty alcohol polyoxythylene ether is a compound represented by the formula $[C_{2n}H_{4n+2}O_{n+1}]$. The fatty alcohol useful as a component of the solid detergent composition can be C5 to C20 fatty alcohols. According to the invention, the solid detergent composition includes about 20 to 30 wt% of the fatty alcohol polyoxythylene ether, preferably about 25 wt% of the fatty alcohol polyoxythylene ether.

[0020] The solid detergent composition includes water softeners. The water softeners combine with magnesium and calcium ions in hard water, resulting in prevention of the magnesium and calcium ions from bonding with components of the solid detergent composition.

[0021] Examples of the water softeners include, but are not limited to, sodium carbonate, potassium carbonate and other similar alkali metal carbonates. According to the invention, the solid detergent composition includes about 15 to 25 wt% of the water softener, preferably about 20 wt% of the water softener.

[0022] The solid detergent composition includes sodium percarbonate. The sodium percarbonate is a colorless, crystalline, and hygroscopic solid that dissolves in water to yield a mixture of hydrogen peroxide and sodium carbonate to function as an oxidizing agent. The hydrogen peroxide, produced by sodium percarbonate's reaction with water, oxidizes any organic stains that comes into contact the hydrogen peroxide and breaks them down. According to the invention, the solid detergent composition includes about 2 to 10 wt% of the sodium percarbonate, preferably about 5 wt% of the sodium percarbonate. In an embodiment, sodium perborate tetrahydrate may also be used instead of sodium percarbonate. Further,

sodium perborate tetrahydrate is environment friendly as it releases comparatively less hydrogen peroxide.

[0023] The solid detergent composition includes sodium silicate. Sodium silicate is an acid salt in the form of a white powder that serves as a strong sequestrant. Further, sodium silicate bolsters preservation and overall shelf-life of the solid detergent composition. Also, sodium silicate is readily soluble in water and produces an alkaline solution that is glassy and colourless. This alkaline solution reacts with acidic components of the solid detergent composition to produce silicic acid that contributes to emulsifying properties of the solid detergent composition. According to the invention, the solid detergent composition includes about 10 to 15 wt% of the sodium silicate, preferably about 10 wt% of the sodium silicate.

[0024] The solid detergent composition also includes sequestering agents that absorb as much as 200 - 300 times the mass of the sequestering agent, resulting in increased emulsification. Examples of the sequestering agents include, but are not limited to, sodium polyacrylate [(-CH2-CH(COONa)-)n] and Ethylenediaminetetraacetic acid (EDTA). Further, according to the invention, the solid detergent composition includes about 5 to 15 wt% of the sequestering agent, preferably about 10 wt% of the sequestering agent.

[0025] The solid detergent composition includes polyvinylpyrrolidone [$(C_6H_9NO)_n$]. Polyvinylpyrrolidone includes a monomer N-vinylpyrrolidone, a light flaky powder, which absorbs up to 40 per cent of the momomer's weight and binds to polar molecules thereby allowing removal of any polar dirt / impurity that needs to be cleaned. Further, according to the invention, the solid detergent composition includes about 5 to 15 wt% of polyvinylpyrrolidone, preferably about 10 wt% of polyvinylpyrrolidone.

[0026] The solid detergent composition also includes enzymes that enable degradation of a protein formed on a surface being cleaned. The enzymes can be usually used to provide desirable activity for removal of protein-based, carbohydrate-based, or triglyceride-based stains from substrates. In an embodiment, the enzymes can act by degrading or altering one or more types of soil residues that need removal. For example, the enzyme can conduct a proteolysis or a protein catabolism by hydrolysis of peptide bonds that link amino acids together in a polypeptide chain forming the protein, thus breaking down these proteins into even simpler forms by intramolecular digestion.

[0027] Examples of enzymes include, but are not limited to, a protease, an amylase, a lipase, a gluconase, a cellulase, a peroxidase, or a mixture thereof of any suitable origin, such as vegetable, animal, bacterial, fungal or yeast origin. Usually bacterial or fungal enzymes are preferred, such as α-amylase and proteases. Further, according to the invention, the solid detergent composition includes about 2 to 10 wt% of the enzymes, preferably about 4 wt% of the enzymes.

[0028] The solid detergent composition also includes sodium sulfate that is a white crystalline solid used to solidify the solid detergent composition. Similarly, alklyl sulfate is also provided to generate a binding effect on all the other ingredients in order to prevent the solid detergent composition from crumbling after it has been formed. Further, according to the invention, the solid detergent composition includes about 10 to 20 wt% each of alkyl sulfate and sodium sulfate, preferably about 15 wt% each of alkyl sulfate and sodium sulfate.

[0029] The solid detergent composition also includes an esculent perfume that provides an agreeable smell to an end-user. For example, in an embodiment, the solid detergent composition includes about 0.5 to 2 wt% of the esculent perfume, preferably about 1 wt% of the esculent perfume.

[0030] However, it should be appreciated that even though the solid detergent composition has been shown to include only the above mentioned components, the solid detergent components can include various other components, without deviating from the scope of the invention. It should be understood that only those components that are essential for functioning of the solid detergent composition have been explained in detail. For example, components like dyes, other aesthetic enhancing agents, other active ingredients, builders, carriers, processing aids, solvents for liquid formulations, hydrotropes, bleaching agents, defoaming agents, optical brighteners, sanitizers etc. may also be included in the composition.

[0031] In some embodiments of the present invention a method for manufacturing the solid detergent composition is also provided. As a first step, the various components of the composition are mixed together in a large tank, for example in a slurry mixer. Moving on, the mixture is further heated to about 80 – 90^{o}C, preferably about 85^{o}C, and stirred until it forms a substantially homogeneous slurry. The substantially homogeneous slurry can be in the form of a liquid or a semi-solid mixture in which the ingredients are distributed throughout its

mass. Preferably, the slurry mixer system includes means for mixing the ingredients to provide shear effective for maintaining the mixture at a flowable consistency.

[0032] Thereafter, the homogeneous slurry can then be de-aerated in a vacuum chamber and then separated in an atomizer into finely divided droplets. The droplets can then be sprayed into a column of air at 400 – 450^{o}C, preferably about 425^{o}C. This enables instantaneous drying of the mixture in the form of a powder. The resultant powder can then be pumped into a double-sided rotary tablet press where it is divided, compressed and cut into tablets which is the final product.

[0033] The solid detergent composition can be available for cleaning in environments including automatic dishwashing or warewashing machines, use as rinse aids therein, laundry, a pot and pan cleaner, cleaner for rotary fryers and deep fat fryers, floors, and for manual cleaning glass, dishes, etc. in a sink. The solid detergent composition can then be dissolved in water and put in contact with substrates to be cleaned. Further, the solid detergent composition is characterized such that it effervesces when in contact with water.

[0034] Various embodiments, as described above, provide a solid detergent composition that has several advantages. For example, the solid detergent composition provided by the invention has a very long shelf life and can stay latent as long as it is kept dry. In contrast, liquid state detergents usually dry up upon prolonged exposure to air. Further, this dehydration often destroys the effective cleaning properties of the liquid detergent. Also, hydration cannot reinstate a dehydrated liquid detergent's original cleaning properties. In comparison, the original cleaning properties of the solid detergent composition proposed here is not compromised because the instantaneous drying of the mixture into powder form as described in the process outlined above, which is highly controlled, helps to preserve these properties.

[0035] Further, the solid state of the detergent composition reduces spillage and wastage to zero. Additionally, the small and light weight properties of this solid state detergent proposed in the invention, allows easy, convenient usage and portability. Further, at the site of action, the solid state detergent can be rapidly deployed in the presence of water. For example, an exemplary tablet of 20 grams is measured to dissolve in 5 litres of water at 3g/minute at a water temperature of 15°C, which increases to 13.3g/minute when dissolved in water at 25°C, and 20g/minute in water at 37°C. Note that the rate of dissolution decreases

to 2g/minute when the tablet is dissolved in water near freezing point at 0°C (even though the product is unlikely to be used in water of this temperature).

[0036] In summary, the solid state of the detergent composition proposed according to the invention makes it a product of unprecedented value.

[0037] While the invention has been disclosed in connection with the preferred embodiments shown and described in detail, various modifications and improvements thereon will become readily apparent to those ordinarily skilled in the art. Accordingly, the spirit and scope of the present invention is not to be limited by the foregoing examples, but is to be understood in the broadest sense allowable by law.

[0038] All documents referenced herein are hereby incorporated by reference.

CLAIMS

1. A solid detergent composition comprising:
   a. a fatty alcohol polyoxythylene ether [$C_{2n}H_{4n+2}O_{n+1}$] from 20% to 30% by weight;
   b. sodium sulfate from 10% to 20% by weight;
   c. sodium percarbonate from 2% to 10% by weight;
   d. sodium silicate from 10% to 15% by weight;
   e. a water softener from 15% to 25% by weight, the water softener being selected from the group comprising sodium carbonate, potassium carbonate, and other alkali metal carbonates;
   f. a sequestering agent from 5% to 15% by weight, the sequestering agent being selected from the group comprising sodium polyacrylate [(-CH2-CH(COONa)-)n] and Ethylenediaminetetraacetic acid (EDTA);
   g. polyvinylpyrrolidone [(C6H9NO)n] from 5% to 15% by weight,
   h. an enzyme from 2% to 10% by weight, the enzyme being selected from the group comprising protease and α-amylase;
   i. an alkyl sulfate from 10% to 20% by weight; and
   j. an esculent perfume from 0.5% to 2% by weight, wherein the solid detergent composition has a dissolution rate of at least 2g/minute in an aqueous solution and operating temperatures of 0° C and above.

2. The solid detergent composition of claim 1, wherein the fatty alcohol polyoxythylene ether is a non-ionic surfactant that lowers surface tension of a liquid for enabling easy cleaning of chosen surfaces.

3. The solid detergent composition of claim 1, wherein the water softener competes with magnesium and calcium ions in hard water, whereby preventing the magnesium and calcium ions from bonding with components of the solid detergent composition.

4. The solid detergent composition of claim 1, wherein the sodium percarbonate dissolves in water to yield a mixture of hydrogen peroxide and sodium carbonate to function as an oxidizing agent.

5. The solid detergent composition of claim 1, wherein the sodium silicate bolsters preservation and shelf-life of the solid detergent composition, further wherein the sodium silicate is readily soluble in water to produce an alkaline solution and reacts with acidic components of the solid detergent composition to produce silicic acid, whereby increasing emulsification by binding colloidal molecules to create larger aggregates.

6. The solid detergent composition of claim 1, wherein the sequestering agent absorbs as much as 200 - 300 times than mass of the sequestering agent, whereby increasing emulsification.

7. The solid detergent composition of claim 1, wherein polyvinylpyrrolidone comprises a monomer N-vinylpyrrolidone that absorbs up to 40 per cent of the monomer's weight and binds to polar molecules.

8. The solid detergent composition of claim 1 wherein the enzyme enables degradation of a protein formed on a surface being cleaned, the enzyme conducting a proteolysis or a protein catabolism by hydrolysis of peptide bonds that link amino acids together in a polypeptide chain forming the protein.

9. The solid detergent composition of claim 1, wherein the esculent perfume provides an agreeable smell to an end-user.

10. The solid detergent composition of claim 1, wherein alkyl sulfate is used to generate a binding effect on all the other ingredients in order to prevent the tablet from crumbling after it is formed through mechanical compression.

11. The solid detergent composition of claim 1, wherein a final product of the solid detergent composition is in the form of a tablet, and a block.

12. The solid detergent composition of claim 1, wherein the solid detergent composition effervesces when in contact with water.