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(71) Applicant *(for all designated States except US)*: **ECOLAB USA INC.** [US/US]; 370 Wabasha Street North, St. Paul, Minnesota 55102 (US).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **SILVERNAIL, Carter** [US/US]; 705 Chicago Drive, Burnsville, Minnesota 55306 (US). **MIRALLES, Altony** [US/US]; 2409 Eyrie Drive, Woodbury, Minnesota 55129 (US). **OLSON, Erik** [US/US]; 12710 Ottawa Avenue, Savage, Minnesota 55378 (US). **HAMMEL, Devon Beau** [US/US]; 749 Mounth Curve Blvd., St. Paul, Minnesota 55116 (US).

(74) Agent: **SORENSEN, Andrew D.**; Ecolab Usa Inc., 655 Lone Oak Drive, Eagan, Minnesota 55121 (US).

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(54) **Title**: METHOD OF REMOVING/PREVENTING REDEPOSITION OF PROTEIN SOILS

(57) **Abstract**: A method and composition is provided for removing protein soil and preventing redeposition of soils onto a surface. The method includes introducing a protein-removing/anti-redeposition agent during a washing step of a wash cycle, introducing a cleaning composition during the washing step of the wash cycle, washing the surface of the substrate with the protein-removing/anti-redeposition agent and the cleaning composition during the wash cycle, and subsequently rinsing the surface of the substrate with a rinse aid. The protein-removing/anti-redeposition agent includes a poly sugar and the cleaning composition includes an alkalinity source and a surfactant component. The composition is substantially free of phosphorus-containing compounds and includes less than about 0.05% by weight alkali earth metal.

METHOD OF REMOVING/PREVENTING REDEPOSITION OF PROTEIN SOILS

TECHNICAL FIELD

[0001] The present invention relates generally to the field of cleaning compositions. In particular, the present invention is a composition for, and method of, removing/preventing redeposition of protein soils.

BACKGROUND

[0002] Conventional detergents used in the warewashing and laundering industries include alkaline detergents. Alkaline detergents, intended for both institutional and consumer use, typically contain phosphates. Phosphates are multifunctional components commonly used in detergents to reduce water hardness as well as increase detergency, anti-redeposition, and crystal modification. Detergency is defined as the ability to wet, emulsify, suspend, penetrate, and dispense soils.

[0003] In particular, polyphosphates such as sodium tripolyphosphate and their salts are used in detergents because of their ability to prevent calcium carbonate precipitation and their ability to disperse and suspend soils. If calcium carbonate is allowed to precipitate, the crystals may attach to the surface being cleaned and cause undesirable effects. For example, calcium carbonate precipitation on the surface of ware can negatively impact the aesthetic appearance of the ware and give the ware an unclean look. In the laundering area, if calcium carbonate precipitates and attaches onto the surface of fabric, the crystals may leave the fabric feeling hard and rough to the touch. In addition to preventing the precipitation of calcium carbonate, the ability of sodium tripolyphosphate to disperse and suspend soils facilitates the detergency of the solution by preventing the soils from redepositing into the wash solution or wash water.

[0004] Due to recent regulations, work has recently been directed to replacing phosphorous in detergents. There is therefore a need in the art for an environmentally friendly multifunctional component that can replace the properties of phosphorous-containing compounds such as phosphates, phosphonates, phosphites, and acrylic phosphinate polymers.

SUMMARY

[0005] In one embodiment, the present invention is a method of removing protein soils from a surface of a substrate and preventing redeposition of protein soils onto the surface of the substrate. The method includes introducing a protein-removing/anti-redeposition agent during a washing step of a wash cycle, introducing a cleaning composition during the washing step of the wash cycle, washing the surface of the substrate with the protein-removing/anti-redeposition agent and the cleaning composition during the wash cycle, and subsequently rinsing the surface of the substrate with a rinse aid. The protein-removing/anti-redeposition agent includes a poly sugar and the cleaning composition includes an alkalinity source and optionally a surfactant component. The surfactant may constitute up to about 15% by weight of the cleaning composition.

[0006] In another embodiment, the present invention is a method for removing protein soils and preventing redeposition of soils onto a surface. The method includes introducing a cleaning composition during a washing step of a wash cycle and introducing a rinse aid during a rinsing step of the wash cycle. The composition includes between about 1% and about 90% by weight poly sugar, between about 1% and about 80% by weight alkalinity source, between about 1% and about 10% by weight surfactant component and less than about 0.05% alkali earth metals.

[0007] In yet embodiment, the present invention is a cleaning composition including a detergent and a rinse aid. The detergent includes a polysugar, an alkalinity source and optionally a surfactant component. A 0.05 to 0.25% solution of the cleaning composition has a pH of between about 10 and about 12.5.

[0008] While multiple embodiments are disclosed, still other embodiments of the present invention will become apparent to those skilled in the art from the following detailed description, which shows and describes illustrative embodiments of the invention. Accordingly, the drawings and detailed description are to be regarded as illustrative in nature and not restrictive.

DETAILED DESCRIPTION

[0009] The present invention relates to cleaning compositions and methods of using the cleaning compositions to remove protein soils from surfaces and to prevent redeposition of the soils on surfaces. The cleaning compositions include an agent for removing protein soil and preventing redeposition including a poly sugar. In one embodiment, the cleaning compositions are substantially free of phosphates. Unlike most cleaning compositions currently known in the art, the cleaning compositions do not have to include phosphates to be effective. Thus, the cleaning compositions of the present invention provide a green replacement for conventional cleaning compositions. The cleaning compositions can be used in various industries, including, but not limited to: warewash (institutional and consumer), food and beverage, health and textile care. In particular, the cleaning compositions can be safely used on glass, ceramic, plastic and metal surfaces.

[0010] The cleaning composition includes a polysugar to aid in removing protein soils/ preventing redeposition of soils onto the surface being cleaned. Polysugars provide an inexpensive alternative to components traditionally employed to remove protein soils and function as an anti-redeposition agent. In addition, polysugars are biodegradable and often classified as Generally Recognized As Safe (GRAS). Exemplary poly sugars include, but are not limited to: amylose, amylopectin, pectin, inulin, modified inulin, potato starch, modified potato starch, corn starch, modified corn starch, wheat starch, modified wheat starch, rice starch, modified rice starch, cellulose, modified cellulose, dextrin, dextran, maltodextrin, cyclodextrin, glycogen and oligiofructose. Particularly suitable poly sugars include, but are not limited to: inulin, carboxymethyl inulin, potato starch, sodium carboxymethylcellulose, linear sulfonated α-(1,4)-linked D-glucose polymers, γ-cyclodextrin and the like. Combinations of poly sugars may also be used.

[0011] The cleaning composition also includes an alkalinity source, such as an alkali metal hydroxide, alkali metal carbonate, or alkali metal silicate. Examples of suitable alkalinity sources include, but are not limited to: sodium hydroxide, potassium hydroxide, sodium carbonate, potassium carbonate or a mixture of alkali metal hydroxide and alkali metal carbonate. Examples of particularly suitable alkalinity sources include, but are not limited to: sodium carbonate, sodium hydroxide, or a mixture of sodium carbonate and sodium hydroxide. The alkalinity source controls the pH of the resulting solution when water is added to the cleaning composition to form a use solution. The pH of the cleaning composition must be maintained in the alkaline range in order to provide sufficient detergency properties. In an exemplary embodiment, at between about a 0.05% and about a 0.25% solution, the pH of the cleaning composition is between approximately 10 and approximately 12.5. If the pH of the cleaning composition is too low, for example, below approximately 10, the cleaning composition may not provide adequate detergency properties. If the pH of the cleaning composition is too high, for example, above approximately 12.5, the cleaning composition may become too alkaline and begin to attack the surface to be cleaned.

[0012] The cleaning composition may also include a surfactant component that functions primarily as a defoamer and as a wetting agent. A variety of surfactants may be used, including anionic, nonionic, cationic, and zwitterionic surfactants. For a discussion of surfactants, see Kirk-Othmer, Encyclopedia of Chemical Technology, Third Edition, volume 8, pages 900-912, which is incorporated herein by reference.

[0013] Examples of suitable anionic surfactants useful in the cleaning composition include, but are not limited to: carboxylates such as alkylcarboxylates (carboxylic acid salts) and polyalkoxycarboxylates, alcohol ethoxylate carboxylates, nonylphenol ethoxylate carboxylates and the like; sulfonates such as alkylsulfonates, alkylbenzenesulfonates, alkylarylsulfonates, sulfonated fatty acid esters and the like; sulfates such as sulfated alcohols, sulfated alcohol ethoxylates, sulfated alkylphenols, alkylsulfates, sulfosuccinates, alkylether sulfates and the like. Some particularly suitable anionic surfactants include, but are not limited to: sodium alkylarylsulfonate, alpha-olefinsulfonate and fatty alcohol sulfates.

[0014] Nonionic surfactants can be used for defoaming and as wetting agents. Exemplary nonionic surfactants useful in the cleaning composition include those having a polyalkylene oxide polymer as a portion of the surfactant molecule. Examples of suitable nonionic surfactants include, but are not limited to: chlorine-, benzyl-, methyl-, ethyl-, propyl, butyl- and alkyl-capped polyethylene glycol ethers of fatty alcohols; polyalkylene oxide free nonionics such as alkyl polyglucosides; sorbitan and sucrose esters and their ethoxylates; alkoxylated ethylene diamine; alcohol alkoxylates such as alcohol ethoxylate propoxylates, alcohol propoxylates, alcohol propoxylate ethoxylate propoxylates, alcohol ethoxylate butoxylates and the like; nonylphenol ethoxylate, polyoxyethylene glycol ethers and the like; carboxylic acid esters such as glycerol esters, polyoxyethylene esters, ethoxylated and glycol esters of fatty acids and the like; carboxylic amides such as diethanolamine condensates, monoalkanolamine condensates, polyoxyethylene fatty acid amides and the like; and polyalkylene oxide block copolymers including an ethylene oxide/propylene oxide block copolymer. Examples of particularly suitable nonionic surfactants include, but are not limited to: a C_{12}-C_{14} fatty alcohol with 3 moles of ethylene oxide (EO) and 6 moles of propylene oxide (PO) and a PO-EO-PO block copolymer surfactant. Examples of suitable commercially available nonionic surfactants include, but are not limited to: PLURONIC 25R2, available from BASF Corporation, Florham Park, NJ; ABIL B8852, available from Goldschmidt Chemical Corporation, Hopewell, VA; and Dehypon LS-36 available from Cognis, headquartered in Monheim, Germany.

[0015] Cationic surfactants useful for inclusion in the cleaning composition include, but are not limited to: amines such as primary, secondary and tertiary amines with C_{18} alkyl or alkenyl chains, ethoxylated alkylamines, alkoxylates of ethylenediamine, imidazoles such as a 1-(2-hydroxyethyl)-2-imidazoline, a 2-alkyl-1-(2-hydroxyethyl)-2-imidazoline and the like; and quaternary ammonium salts, as for example, alkylquaternary ammonium chloride surfactants such as n-alkyl(C_{12} -C_{18})dimethylbenzyl ammonium chloride, n-tetradecyldimethylbenzylammonium chloride monohydrate, and naphthalene-substituted quaternary ammonium chlorides such as dimethyl-1-naphthylmethylammonium chloride. For a more extensive list of surfactants, see McCutcheon's Emulsifiers and Detergents, which is incorporated herein by reference.

[0016] In concentrate form, the component concentrations of the cleaning compositions will vary depending on whether the cleaning composition is in solid or liquid form. In solid form, the cleaning compositions include between about 1 wt% and about 90 wt% poly sugar, between about 1 wt% and about 80 wt% alkalinity source and up to about 15 wt% surfactant component. Particularly, the cleaning compositions include between about 1 wt% and about 60 wt% poly sugar, between about 1 wt% and about 65 wt% alkalinity source and between about 1 wt% and about 10 wt% surfactant component. More particularly, the cleaning compositions include between about 1 wt% and about 35 wt% poly sugar, between about 1 wt% and about 55 wt% alkalinity source and between about 1 wt% and about 5 wt% surfactant component. In other embodiments, similar concentrations may also be present in the cleaning compositions of the invention.

[0017] In liquid form, the cleaning compositions include between about 1 wt% and about 60 wt% poly sugar, between about 1 wt% and about 40 wt% alkalinity source and between about 1 wt% and about 15 wt% surfactant component. Particularly, the cleaning compositions include between about 1 wt% and about 40 wt% poly sugar, between about 1 wt% and about 25 wt% alkalinity source and between about 1 wt% and about 10 wt% surfactant component. More particularly, the cleaning compositions include between about 1 wt% and about 20 wt% poly sugar, between about 1 wt% and about 15 wt% alkalinity source and between about 1 wt% and about 3 wt% surfactant component. In other embodiments, similar concentrations may also be present in the cleaning compositions of the invention.

[0018] In one embodiment, the protein-removing/anti-redeposition agent constitutes between about 0.1 wt% and about 85 wt% of the cleaning composition. Particularly, the protein-removing/anti-redeposition agent constitutes between about 1 wt% and about 60 wt% of the cleaning composition. More particularly, the protein-removing/anti-redeposition agent constitutes between about 2 wt% and about 20 wt% of the cleaning composition.

[0019] The cleaning composition is also substantially free of phosphorus-containing compounds. Substantially phosphorus-free refers to a composition to which phosphorus-containing compounds are not added. In an exemplary embodiment, the cleaning composition includes less than approximately 2 wt% phosphates, phosphonates, and phosphites, or mixtures thereof. Particularly, the cleaning composition includes less than approximately 1 wt% phosphates, phosphonates, and phosphites. More particularly, the cleaning composition includes less than approximately 0.5 wt% phosphates, phosphonates, and phosphites. Most particularly, the cleaning composition includes less than approximately 0.1 wt% phosphates, phosphonates, and phosphites.

[0020] In one embodiment, the cleaning composition is also substantially free of alkali earth metals. Substantially alkali earth metal-free refers to a composition to which alkali earth metals are not added. In an exemplary embodiment, the cleaning composition includes less than approximately 1 wt% alkali earth metals, or mixtures thereof by weight. Particularly, the cleaning composition includes less than approximately 0.5 wt% alkali earth metals. More particularly, the cleaning composition includes less than approximately 0.1 wt% alkali earth metals. Most particularly, the cleaning composition includes less than approximately 0.05 wt% alkali earth metals.

[0021] The cleaning composition can optionally include a rinse aid composition, for example a rinse aid formulation containing a wetting or sheeting agent combined with other optional ingredients in a solid composition made using the binding agent. The rinse aid components are capable of reducing the surface tension of the rinse water to promote sheeting action and/or to prevent spotting or streaking caused by beaded water after rinsing is complete, for example in warewashing processes. Examples of sheeting agents include, but are not limited to: polyether compounds prepared from ethylene oxide, propylene oxide, or a mixture in a homopolymer or block or heteric copolymer structure. Such polyether compounds are known as polyalkylene oxide polymers, polyoxyalkylene polymers or polyalkylene glycol polymers. Such sheeting agents require a region of relative hydrophobicity and a region of relative hydrophilicity to provide surfactant properties to the molecule. When a rinse aid composition is used, it can be present at about 1 to about 5 milliliters per cycle, wherein one cycle includes about 6.5 liters of water.

Additional Functional Materials

[0022] The cleaning compositions can include additional components or agents, such as additional functional materials. As such, in some embodiments, the cleaning composition including the protein-removing/anti-redeposition agent, alkalinity source and surfactant component may provide a large amount, or even all of the total weight of the cleaning composition, for example, in embodiments having few or no additional functional materials disposed therein. The functional materials provide desired properties and functionalities to the cleaning composition. For the purpose of this application, the term "functional materials" include a material that when dispersed or dissolved in a use and/or concentrate solution, such as an aqueous solution, provides a beneficial property in a particular use. The cleaning compositions containing the protein-removing/anti-redeposition agent, alkalinity source and surfactant component may optionally contain other soil-digesting components, surfactants, disinfectants, sanitizers, acidulants, complexing agents, corrosion inhibitors, foam inhibitors, dyes, thickening or gelling agents, and perfumes, as described, for example, in U.S. Patent No. 7,341,983, incorporated herein by reference. Some particular examples of functional materials are discussed in more detail below, but it should be understood by those of skill in the art and others that the particular materials discussed are given by way of example only, and that a broad variety of other functional materials may be used. For example, many of the functional materials discussed below relate to materials used in cleaning and/or destaining applications, but it should be understood that other embodiments may include functional materials for use in other applications.

Thickening Agents

[0023] Thickeners useful in the present invention include those compatible with acidic systems. The viscosity of the cleaning composition increases with the amount of thickening agent, and viscous compositions are useful for uses where the cleaning composition clings to the surface. Suitable thickeners can include those which do not leave contaminating residue on the surface to be treated. Generally, thickeners which may be used in the present invention include natural gums such as xanthan gum, guar gum, modified guar, or other gums from plant mucilage; polysaccharide based thickeners, such as alginates, starches, and cellulosic polymers (e.g., carboxymethyl cellulose, hydroxyethyl cellulose, and the like); polyacrylates thickeners; and hydrocolloid thickeners, such as pectin. Generally, the concentration of thickener employed in the present compositions or methods will be dictated by the desired viscosity within the final composition. However, as a general guideline, the viscosity of thickener within the present composition ranges from about 0.1 wt% to about 3 wt%, from about 0.1 wt% to about 2 wt%, or about 0.1 wt% to about 0.5 wt%.

Dyes and Fragrances

[0024] Various dyes, odorants including perfumes, and other aesthetic enhancing agents may also be included in the cleaning composition. Dyes may be included to alter the appearance of the composition, as for example, any of a variety of FD&C dyes, D&C dyes, and the like. Additional suitable dyes include Direct Blue 86 (Miles), Fastusol Blue (Mobay Chemical Corp.), Acid Orange 7 (American Cyanamid), Basic Violet 10 (Sandoz), Acid Yellow 23 (GAF), Acid Yellow 17 (Sigma Chemical), Sap Green (Keystone Aniline and Chemical), Metanil Yellow (Keystone Aniline and Chemical), Acid Blue 9 (Hilton Davis), Sandolan Blue/Acid Blue 182 (Sandoz), Hisol Fast Red (Capitol Color and Chemical), Fluorescein (Capitol Color and Chemical), Acid Green 25 (Ciba-Geigy), Pylakor Acid Bright Red (Pylam), and the like. Fragrances or perfumes that may be included in the compositions include, for example, terpenoids such as citronellol, aldehydes such as amyl cinnamaldehyde, a jasmine such as C1S-jasmine or jasmal, vanillin, and the like.

Bleaching Agents

[0025] The cleaning composition can optionally include a bleaching agent for lightening or whitening a substrate, and can include bleaching compounds capable of liberating an active halogen species, such as Cl_2, Br_2, -OCl- and/or -OBr-, or the like, under conditions typically encountered during the cleansing process. Examples of suitable bleaching agents include, but are not limited to: chlorine-containing compounds such as chlorine, a hypochlorite or chloramines. Examples of suitable halogen-releasing compounds include, but are not limited to: alkali metal dichloroisocyanurates, alkali metal hypochlorites, monochloramine, and dichloroamine. Encapsulated chlorine sources may also be used to enhance the stability of the chlorine source in the composition (see, for example, U.S. Pat. Nos. 4,618,914 and 4,830,773, the disclosures of which are incorporated by reference herein). The bleaching agent may also include an agent containing or acting as a source of active oxygen. The active oxygen compound acts to provide a source of active oxygen and may release active oxygen in aqueous solutions. An active oxygen compound can be inorganic, organic or a mixture thereof. Examples of suitable active oxygen compounds include, but are not limited to: peroxygen compounds, peroxygen compound adducts, hydrogen peroxide, perborates, sodium carbonate peroxyhydrate, phosphate peroxyhydrates, potassium permonosulfate, and sodium perborate mono and tetrahydrate, with and without activators such as tetraacetylethylene diamine.

Sanitizers/Anti-Microbial Agents

[0026] The cleaning composition can optionally include a sanitizing agent (or antimicrobial agent). Sanitizing agents, also known as antimicrobial agents, are chemical compositions that can be used to prevent microbial contamination and deterioration of material systems, surfaces, etc. Generally, these materials fall in specific classes including phenolics, halogen compounds, quaternary ammonium compounds, metal derivatives, amines, alkanol amines, nitro derivatives, anilides, organosulfur and sulfur-nitrogen compounds and miscellaneous compounds.

[0027] The given antimicrobial agent, depending on chemical composition and concentration, may simply limit further proliferation of numbers of the microbe or may destroy all or a portion of the microbial population. The terms "microbes" and "microorganisms" typically refer primarily to bacteria, virus, yeast, spores, and fungus microorganisms. In use, the antimicrobial agents are typically formed into a solid functional material that when diluted and dispensed, optionally, for example, using an aqueous stream forms an aqueous disinfectant or sanitizer composition that can be contacted with a variety of surfaces resulting in prevention of growth or the killing of a portion of the microbial population. A three log reduction of the microbial population results in a sanitizer composition. The antimicrobial agent can be encapsulated, for example, to improve its stability.

[0028] Examples of suitable antimicrobial agents include, but are not limited to, phenolic antimicrobials such as pentachlorophenol; orthophenylphenol; chloro-p-benzylphenols; p-chloro-m-xylenol; quaternary ammonium compounds such as alkyl dimethylbenzyl ammonium chloride; alkyl dimethylethylbenzyl ammonium chloride; octyl decyldimethyl ammonium chloride; dioctyl dimethyl ammonium chloride; and didecyl dimethyl ammonium chloride. Examples of suitable halogen containing antibacterial agents include, but are not limited to: sodium trichloroisocyanurate, sodium dichloro isocyanate (anhydrous or dihydrate), iodine-poly(vinylpyrolidinone) complexes, bromine compounds such as 2-bromo-2-nitropropane-1,3-diol, and quaternary antimicrobial agents such as benzalkonium chloride, didecyldimethyl ammonium chloride, choline diiodochloride, and tetramethyl phosphonium tribromide. Other antimicrobial compositions such as hexahydro-1,3,5-tris(2-hydroxyethyl)-s-triazine, dithiocarbamates such as sodium dimethyldithiocarbamate, and a variety of other materials are known in the art for their antimicrobial properties.

[0029] It should also be understood that active oxygen compounds, such as those discussed above in the bleaching agents section, may also act as antimicrobial agents, and can even provide sanitizing activity. In fact, in some embodiments, the ability of the active oxygen compound to act as an antimicrobial agent reduces the need for additional antimicrobial agents within the composition. For example, percarbonate compositions have been demonstrated to provide excellent antimicrobial action.

Activators

[0030] In some embodiments, the antimicrobial activity or bleaching activity of the cleaning composition can be enhanced by the addition of a material which, when the cleaning composition is placed in use, reacts with the active oxygen to form an activated component. For example, in some embodiments, a peracid or a peracid salt is formed. For example, in some embodiments, tetraacetylethylene diamine can be included within the detergent composition to react with the active oxygen and form a peracid or a peracid salt that acts as an antimicrobial agent. Other examples of active oxygen activators include transition metals and their compounds, compounds that contain a carboxylic, nitrile, or ester moiety, or other such compounds known in the art. In an embodiment, the activator includes tetraacetylethylene diamine; transition metal; compound that includes carboxylic, nitrile, amine, or ester moiety; or mixtures thereof. In some embodiments, an activator for an active oxygen compound combines with the active oxygen to form an antimicrobial agent.

[0031] In some embodiments, the cleaning composition is in the form of a solid block, and an activator material for the active oxygen is coupled to the solid block. The activator can be coupled to the solid block by any of a variety of methods for coupling one solid detergent composition to another. For example, the activator can be in the form of a solid that is bound, affixed, glued or otherwise adhered to the solid block. Alternatively, the solid activator can be formed around and encasing the block. By way of further example, the solid activator can be coupled to the solid block by the container or package for the detergent composition, such as by a plastic or shrink wrap or film.

Builders or Fillers

[0032] The cleaning composition can optionally include a minor but effective amount of one or more of a filler which does not necessarily perform as a cleaning agent per se, but may cooperate with a cleaning agent to enhance the overall cleaning capacity of the composition. Examples of suitable fillers include, but are not limited to: sodium sulfate, sodium chloride, starch, sugars, and C1 -C10 alkylene glycols such as propylene glycol.

pH Buffering Agents

[0033] Additionally, the cleaning composition can be formulated such that during use in aqueous operations, for example in aqueous cleaning operations, the wash water will have a desired pH. For example, a souring agent may be added to the cleaning composition such that the pH of the textile approximately matches the proper processing pH. The souring agent is a mild acid used to neutralize residual alkalines and reduce the pH of the textile such that when the garments come into contact with human skin, the textile does not irritate the skin. Examples of suitable souring agents include, but are not limited to: phosphoric acid, formic acid, acetic acid, hydrofluorosilicic acid, saturated fatty acids, dicarboxylic acids, tricarboxylic acids, and any combination thereof. Examples of saturated fatty acids include, but are not limited to: those having 10 or more carbon atoms such as palmitic acid, stearic acid, and arachidic acid (C_{20}). Examples of dicarboxylic acids include, but are not limited to: oxalic acid, tartaric acid, glutaric acid, succinic acid, adipic acid, and sulfamic acid. Examples of tricarboxylic acids include, but are not limited to: citric acid and tricarballylic acids. Examples of suitable commercially available souring agents include, but are not limited to: TurboLizer, Injection Sour, TurboPlex, AdvaCare 120 Sour, AdvaCare 120 Sanitizing Sour, CarboBrite, and Econo Sour, all available from Ecolab Inc., St. Paul, MN.

Defoaming Agents

[0034] The cleaning composition can optionally include a minor but effective amount of a defoaming agent for reducing the stability of foam. Examples of suitable defoaming agents include, but are not limited to: silicone compounds such as silica dispersed in polydimethylsiloxane, fatty amides, hydrocarbon waxes, fatty acids, fatty esters, fatty alcohols, fatty acid soaps, ethoxylates, mineral oils, polyethylene glycol esters, and alkyl phosphate esters such as monostearyl phosphate. A discussion of defoaming agents may be found, for example, in U.S. Pat. Nos. 3,048,548 to Martin et al., 3,334,147 to Brunelle et al., and 3,442,242 to Rue et al., the disclosures of which are incorporated by reference herein.

Anti-Redeposition Agents

[0035] The cleaning composition can optionally include an additional anti-redeposition agent capable of facilitating sustained suspension of soils in a cleaning solution and preventing the removed soils from being redeposited onto the substrate being cleaned. Examples of suitable anti-redeposition agents include, but are not limited to: fatty acid amides, fluorocarbon surfactants, complex phosphate esters, polyacrylates, styrene maleic anhydride copolymers, and cellulosic derivatives such as hydroxyethyl cellulose, hydroxypropyl cellulose.

Stabilizing Agents

[0036] The cleaning composition may also include stabilizing agents. Examples of suitable stabilizing agents include, but are not limited to: borate, calcium/magnesium ions, propylene glycol, and mixtures thereof.

Dispersants

[0037] The cleaning composition may also include dispersants. Examples of suitable dispersants that can be used in the solid detergent composition include, but are not limited to: maleic acid/olefin copolymers, polyacrylic acid, and mixtures thereof.

Hardening Agents/Solubility Modifiers

[0038] The cleaning composition may include a minor but effective amount of a hardening agent. Examples of suitable hardening agents include, but are not limited to: an amide such stearic monoethanolamide or lauric diethanolamide, an alkylamide, a solid polyethylene glycol, a solid EO/PO block copolymer, starches that have been made water-soluble through an acid or alkaline treatment process, and various inorganics that impart solidifying properties to a heated composition upon cooling. Such compounds may also vary the solubility of the composition in an aqueous medium during use such that the cleaning agent and/or other active ingredients may be dispensed from the solid composition over an extended period of time.

Adjuvants

[0039] The present composition can also include any number of adjuvants. Specifically, the cleaning composition can include stabilizing agents, wetting agents, foaming agents, corrosion inhibitors, biocides and hydrogen peroxide among any number of other constituents which can be added to the composition. Such adjuvants can be pre-formulated with the present composition or added to the system simultaneously, or even after, the addition of the present composition. The cleaning composition can also contain any number of other constituents as necessitated by the application, which are known and which can facilitate the activity of the present compositions.

Embodiments of the Present Compositions

[0040] Exemplary concentrate compositions are provided in the following tables.

Table 1. Exemplary Composition #1 (Liquid)

Component	Range (Wt %)	Range (Wt %)	Range (Wt %)
Alkalinity Source	1-40	1-25	1-15
Filler	0-10	0-10	0-10
Surfactants	0-10	0-6	0-3
Builder	1-20	1-15	1-10
Water	0-90	0-60	0-40
Poly Sugar	1-60	1-40	1-20

Table 2. Exemplary Composition #2 (Solid)

Component	Range (Wt %)	Range (Wt %)	Range (Wt %)
Alkalinity Source	1-80	1-65	1-55
Filler	1-60	1-40	1-20
Surfactants	0-15	0-10	0-5
Builder	1-40	1-25	1-15
Water	0-35	0-25	0-20
Poly Sugar	1-90	1-60	1-35

[0041] The concentrate composition of the present invention can be provided as a solid, liquid, or gel, or a combination thereof. In one embodiment, the cleaning compositions may be provided as a concentrate such that the cleaning composition is substantially free of any added water or the concentrate may contain a nominal amount of water. The concentrate can be formulated without any water or can be provided with a relatively small amount of water in order to reduce the expense of transporting the concentrate. For example, the composition concentrate can be provided as a capsule or pellet of compressed powder, a solid, or loose powder, either contained by a water soluble material or not. In the case of providing the capsule or pellet of the composition in a material, the capsule or pellet can be introduced into a volume of water, and if present the water soluble material can solubilize, degrade, or disperse to allow contact of the composition concentrate with the water. For the purposes of this disclosure, the terms “capsule” and “pellet” are used for exemplary purposes and are not intended to limit the delivery mode of the invention to a particular shape.

[0042] When provided as a liquid concentrate composition, the concentrate can be diluted through dispensing equipment using aspirators, peristaltic pumps, gear pumps, mass flow meters, and the like. This liquid concentrate embodiment can also be delivered in bottles, jars, dosing bottles, bottles with dosing caps, and the like. The liquid concentrate composition can be filled into a multi-chambered cartridge insert that is then placed in a spray bottle or other delivery device filled with a pre-measured amount of water.

[0043] In yet another embodiment, the concentrate composition can be provided in a solid form that resists crumbling or other degradation until placed into a container. Such container may either be filled with water before placing the composition concentrate into the container, or it may be filled with water after the composition concentrate is placed into the container. In either case, the solid concentrate composition dissolves, solubilizes, or otherwise disintegrates upon contact with water. In a particular embodiment, the solid concentrate composition dissolves rapidly thereby allowing the concentrate composition to become a use composition and further allowing the end user to apply the use composition to a surface in need of cleaning.

[0044] In another embodiment, the solid concentrate composition can be diluted through dispensing equipment whereby water is sprayed at the solid block forming the use solution. The water flow is delivered at a relatively constant rate using mechanical, electrical, or hydraulic controls and the like. The solid concentrate composition can also be diluted through dispensing equipment whereby water flows around the solid block, creating a use solution as the solid concentrate dissolves. The solid concentrate composition can also be diluted through pellet, tablet, powder and paste dispensers, and the like.

[0045] When the cleaning composition includes water in the concentrate, it should be appreciated that the water may be provided as deionized water or as softened water The water provided as part of the concentrate can be relatively free of hardness. It is expected that the water can be deionized to remove a portion of the dissolved solids. Although deionized water is preferred for formulating the concentrate, the concentrate can be formulated with water that has not been deionized. That is, the concentrate can be formulated with water that includes dissolved solids, and can be formulated with water that can be characterized as hard water.

[0046] The water used to dilute the concentrate (water of dilution) can be available at the locale or site of dilution. The water of dilution may contain varying levels of hardness depending upon the locale. Service water available from various municipalities have varying levels of hardness. It is desirable to provide a concentrate that can handle the hardness levels found in the service water of various municipalities. The water of dilution that is used to dilute the concentrate can be characterized as hard water when it includes at least 1 grain hardness. It is expected that the water of dilution can include at least 5 grains hardness, at least 10 grains hardness, or at least 20 grains hardness.

[0047] It is expected that the concentrate will be diluted with the water of dilution in order to provide a use solution having a desired level of detersive properties. If the use solution is required to remove tough or heavy soils, it is expected that the concentrate can be diluted with the water of dilution at a weight ratio of at least 1:1 and up to 1:8. If a light duty cleaning use solution is desired, it is expected that the concentrate can be diluted at a weight ratio of concentrate to water of dilution of up to about 1:256.

[0048] In an alternate embodiment, the cleaning compositions may be provided as a ready-to-use (RTU) composition. If the cleaning composition is provided as a RTU composition, a more significant amount of water is added to the cleaning composition as a diluent. When the concentrate is provided as a liquid, it may be desirable to provide it in a flowable form so that it can be pumped or aspirated. It has been found that it is generally difficult to accurately pump a small amount of a liquid. It is generally more effective to pump a larger amount of a liquid. Accordingly, although it is desirable to provide the concentrate with as little as possible in order to reduce transportation costs, it is also desirable to provide a concentrate that can be dispensed accurately. In the case of a liquid concentrate, it is expected that water will be present in an amount of up to about 90 wt%, particularly between about 20 wt% and about 85 wt%, more particularly between about 30 wt% and about 80 wt.% and most particularly between about 50 wt% and about 80 wt %.

[0049] In the case of a RTU composition, it should be noted that the above-disclosed cleaning composition may, if desired, be further diluted with up to about 96 wt% water, based on the weight of the cleaning composition.

[0050] In use, a cleaning composition including the protein-removing/anti-redeposition agent is applied to a surface to be washed during a washing step of a wash cycle. A wash cycle may include at least a washing step and a rinsing step and may optionally also include a pre-rinsing step. The wash cycle involves dissolving a cleaning composition, which may include components such as, for example, alkalinity sources, builders, surfactants, corrosion inhibitors and the like. During the rinsing step, generally warm or hot water flows over the surfaces to be washed. The rinse water may include components such as, for example, surfactants or rinse aids. The cleaning composition including the protein-removing/anti-redeposition agent of the present invention is used only during the washing step of the wash cycle and is not used during the rinsing step.

[0051] During the washing step, the cleaning composition including the protein-removing/anti-redeposition agent contacts the surface and works to clean protein and other residue from the surface. In addition, the protein-removing/anti-redeposition agent aids in preventing soils from depositing onto the surface. Although the poly sugar-based protein-removing/anti-redeposition agent is discussed as being a part of the cleaning composition, the poly sugar can optionally be added to the washing step of the wash cycle as a separate component. Thus, in one embodiment, the poly sugar is introduced into the washing step of a wash cycle independent of a detergent composition. When provided as a separate component, the poly sugar may be provided at a relatively high level of poly sugar, up to about 100%, in liquid or solid form and may be introduced manually or automatically.

[0052] The ability of the cleaning composition to reduce the amount of residual water can be enhanced by contacting the ware with a rinse aid composition during the rinsing step of a wash cycle. The rinse aid composition significantly decreases the amount of residual water left on ware cleaned with the cleaning composition. The rinse aid composition is present during the rinsing step at between about 1 and about 5 mL per rinse cycle (a rinse cycle is about 6.5 L of water).

[0053] Compositions of the invention may be useful to clean a variety of surfaces. Invention compositions may be used to clean soils on hard surfaces including but not limited to: ceramics, ceramic tile, grout, granite, concrete, mirrors, enameled surfaces, metals including aluminum, brass, stainless steel, glass, plastic and the like. Compositions of the invention may also be used to clean soiled linens such as towels, sheets, and nonwoven webs. As such, compositions of the invention are useful to formulate hard surface cleaners, laundry detergents, oven cleaners, hand soaps, automotive detergents, and warewashing detergents whether automatic or manual.

EXAMPLES

[0054] The present invention is more particularly described in the following examples that are intended as illustrations only, since numerous modifications and variations within the scope of the present invention will be apparent to those skilled in the art. Unless otherwise noted, all parts, percentages, and ratios reported in the following examples are on a weight basis, and all reagents used in the examples were obtained, or are available, from the chemical suppliers described below, or may be synthesized by conventional techniques.

Materials Used

[0055] Dehypon LS-36: a C_{12}-C_{14} fatty alcohol with 3 moles of ethylene oxide (EO) and 6 moles of propylene oxide (PO) available from Cognis, headquartered in Monheim, Germany.

[0056] Pluronic 25R2: a PO-EO-PO block copolymer surfactant available from BASF Corporation, Florham Park, NJ.

[0057] Dequest pb11615 (25%): a carboxymethyl inulin, sodium salt solution, available from Thermphos, Wittenburg, Germany.

[0058] Cyclodextrin: a γ-cyclodextrin having 8 glucopyranoside units available from Wacker Fine Chemicals, Munich, Germany.

[0059] Acusol 445ND: a sodium polyacrylate (molecular weight 4,500g/mol) polymer available from Rohm & Haas Company, Philadelphia, PA.

[0060] Dextrin Sulfate: a linear sulfonated α-(1,4)-linked D-glucose polymer. The Dextrin sulfate was synthesized by first weighing about 34 grams of glacial acetic acid on a 100 ml dry Erlenmeyer flask. The flask was capped and cooled in an ice bath until the glacial acetic acid began to crystallize. In a hood, about 20 grams of chlorosulfonic acid was removed and added dropwise to the flask containing the glacial acetic acid in the ice bath. The flask was then capped and kept on the ice bath. Separately, about 16 grams of dextrin was dissolved on about 40 grams of ice cold glacial acetic acid. The ice cold chlorosulfonic acid solution was added to the ice cold dextrin-acetic acid. The solution was mixed continuously and heated to room temperature overnight. About 160 ml of ice-cold deionized water was added dropwise over a period of about one hour to avoid an out of control hydrolysis of the excess chlorosulfonic acid. The cooling and slow agitation was maintained during this time. Alcohol was added to the mix to precipitate soft brown dextrin sulfate. The precipitated mass was filtered out and washed several times with alcohol until a small sample dissolved in water gave a pH of about 3. The white powder product obtained was then slurred in about 18 grams of 85% isopropanol and 10% NaOH was added until the pH gave a value of about 6.5. A 150 ml of i-propanol was added to precipitate a light brown, soft, sticky sodium dextrin sulfate. The alcohol was decanted and the dextrin sulfate was rinsed with about 40 ml of i-propanol. The i-propanol was then decanted and the dextrin sulfate was rinsed with about 40 ml of acetone two times. After decanting the acetone, the product was allowed air dry while mixing with a spatula to avoid the formation of clumps. The final yield was about 13 grams of a light cream colored powder.

Multi-Cycle Spot, Film and Soil Removal Test

[0061] To test the ability of compositions to clean glass and plastic, twelve 10 oz. Libbey heat resistant glass tumblers and four Newport plastic tumblers were used. The glass tumblers were cleaned prior to use. New plastic tumblers were used for each 7 cycle experiment.

[0062] A food soil solution was prepared using a 50/50 combination of beef stew and hot point soil. The concentration of the solution was about 2000 ppm. The soil included two cans of Dinty Moore Beef Stew (1360 grams), one large can of tomato sauce (822 grams), 15.5 sticks of Blue Bonnet Margarine (1746 grams) and powered milk (436.4 grams).

[0063] After filling the dishmachine with 5 grain water, the heaters were turned on. The final rinse temperature was adjusted to about 180 °F. The glasses and plastic tumblers were soiled by rolling the glasses in a 1:1 (by volume) mixture of Campbell's Cream of Chicken Soup: Kemp's Whole Milk three times. The glasses were then placed in an oven at about 160 °F for about 8 minutes. While the glasses were drying, the dishmachine was primed with about 120 grams of the food soil solution, which corresponds to about 2000 ppm of food soil in the sump.

[0064] The soiled glass and plastic tumblers were placed in the Raburn rack (see figure below for arrangement; P = plastic tumbler; G = glass tumbler) and the rack was placed inside the dishmachine. The first two columns with the tumblers were tested for soil removal while the second two columns with the tumblers were tested for redeposition.

		G	G		
		G	G		
	P	G	G	P	
	P	G	G	P	
		G	G		
		G	G		

[0065] The dishmachine was then started and run through an automatic cycle. When the cycle ended, the top of the glass and plastic tumblers were mopped with a dry towel. The glass and plastic tumblers being tested for soil removal were removed and the soup/milk soiling procedure was repeated. The redeposition glass and plastic tumblers were not removed.

[0066] At the beginning of each cycle, an appropriate amount of detergent and food soil were added to the wash tank to make up for the rinse dilution. The soiling and washing steps were repeated for seven cycles.

[0067] The glass and plastic tumblers were then graded for protein accumulation using Commassie Brilliant Blue R stain followed by destaining with an aqueous acetic acid/methanol solution. The Commassie Brilliant Blue R stain was prepared by combining 1.25g of Commassie Brilliant Blue R dye with 45mL of acetic acid and 455mL of 50% methanol in distilled water. The destaining solution consisted of 45% methanol and 10% acetic acid in distilled water. The amount of protein remaining on the glass and plastic tumblers after destaining was rated visually on a scale of 1 to 5. A rating of 1 indicated no protein was present after destaining. A rating of 2 indicated that random areas (barely perceptible) were covered with protein after destaining. A rating of 3 indicated that about a quarter to half of the surface was covered with protein after destaining. A rating of 4 indicated that about half to three quarters of the glass/plastic surface was covered with protein after destaining. A rating of 5 indicated that the entire surface was coated with protein after destaining.

[0068] The ratings of the glass tumblers tested for soil removal were averaged to determine an average soil removal rating from glass surfaces and the ratings of the plastic tumblers tested for soil removal were averaged to determine an average soil removal rating from plastic surfaces. Similarly, the ratings of the glass tumblers tested for redeposition were averaged to determine an average redeposition rating for glass surfaces and the ratings of the plastic tumblers tested for redeposition were averaged to determine an average redeposition rating for plastic surfaces.

<u>Examples 1, 2, 3, 4, 5 and 6 and Comparative Example A</u>

[0069] Examples 1, 2, 3, 4, 5 and 6 are compositions of the present invention with component concentrations (in weight percent) of sodium carbonate (soda ash or dense ash), sodium bicarbonate, mono ash, sodium metasilicate, a surfactant premix, potassium hydroxide (45%), water, sodium citrate dehydrate and various poly sugars, as provided in Table 3. The surfactant premix including the Dehypon LS-36 and Pluronic 25R2 was first mixed together before combining with the remainder of the components.

[0070] The compositions of Examples 1, 2, 3, 4, 5 and 6 included about 30 ppm of a poly sugar. In particular, the composition of Example 1 included inulin, the composition of Example 2 included Dequest Pb 11615, the composition of Example 3 included a soluble potato starch, the composition of Example 4 included sodium carboxymethylcellulose (CMC), also known as carmellose, the composition of Example 5 included Dextrin Sulfate and the composition of Example 6 included cyclodextrin.

[0071] The composition of Comparative Example A was prepared similarly to the compositions of Examples 1, 2, 3, 4, 5 and 6 except that the composition of Comparative Example A did not include a poly sugar.

[0072] Table 3 provides the component concentrations for the compositions of Examples 1, 2, 3, 4, 5 and 6 and Comparative Example A.

Table 3.

Component	Example 1 (wt%)	Example 2 (wt%)	Example 3 (wt%)	Example 4 (wt%)	Example 5 (wt%)	Example 6 (wt%)	Comp. Ex. A (wt%)
Dense Ash	61.19	55.46	61.19	61.19	61.19	61.19	60.66
Sodium bicarbonate	3.27	0	3.27	3.27	3.27	3.27	6.8
Mono Ash	12.95	12.95	12.95	12.95	12.95	12.95	12.95
Sodium metasilicate	3.16	3.16	3.16	3.16	3.16	3.16	3.16
Dehypon LS-36	3.53	3.53	3.53	3.53	3.53	3.53	3.53
Pluronic 25R2	1.06	1.06	1.06	1.06	1.06	1.06	1.06
KOH (45%)	2.08	2.08	2.08	2.08	2.08	2.08	2.08
Water	4	4	4	4	4	4	4
Sodium citrate dehydrate	5.76	5.76	5.76	5.76	5.76	5.76	5.76
Inulin	3	0	0	0	0	0	0
Dequest Pb 11615	0	12	0	0	0	0	0
Potato Starch	0	0	3	0	0	0	0
Sodium CMC	0	0	0	3	0	0	0
Dextrin Sulfate	0	0	0	0	3	0	0
Cyclodextrin	0	0	0	0	0	3	0

[0073] The compositions of Examples 1, 2, 3, 4, 5 and 6 and Comparative Example A were tested for soil removal and anti-redeposition properties according to the method described above. Table 4 provides the average visual ratings for the glass and plastic tumblers treated with the compositions of Examples 1, 2, 3, 4, 5 and 6 and Comparative Example A. Generally, an average rating of 3 or below, and particularly an average rating of 2 or below, is considered acceptable.

Table 4.

	Example 1	Example 2	Example 3	Example 4	Example 5	Example 6	Comp. Ex. A
Soil Removal							
Av. Glass Rating	2.25	2.25	2.33	2.67	4.58	2.67	4.92
Av. Plastic Rating	2.25	4	3.5	5	5	3	5
Redeposition							
Av. Glass	1	1	1	1	1	1	1.58

Rating							
Av. Plastic Rating	1	1.5	1	2.63	2.63	1	2.5

[0074] As can be seen in Table 4, all of the compositions of Examples 1-6 including about 30 ppm of a poly sugar outperformed the composition of Comparative Example A at removing soil from glass. The compositions of Examples 1-6 also performed substantially similarly or outperformed the composition of Comparative Example A at removing soil from plastic. With regard to preventing redeposition of soils, the compositions of Examples 1-6 outperformed the composition of Comparative Example A at preventing redeposition of soils onto glass. All of the compositions of Examples 1-6 also had acceptable ratings for preventing redeposition of soils onto plastic.

[0075] In particular, the compositions of Examples 1, 2, 3 and 6, which included about 30 ppm inulin, carboxymethyl inulin, potato starch and cyclodextrin, respectively, outperformed the composition of Comparative Example A at removing soils from glass and plastic and at preventing redeposition of soils onto glass and plastic. All of the compositions of Examples 1, 2, 3 and 6 performed at acceptable levels for removing soils from glass and preventing redeposition onto glass. The compositions of Examples 1, 2, 3 and 6 also performed at acceptable levels for preventing redeposition of soils onto plastic.

[0076] The compositions of Examples 4 and 5, which included about 30 ppm sodium CMC and dextrin sulfate, respectively, outperformed the composition of Comparative Example A at removing soils from glass and preventing redeposition onto glass. When the same tests were performed using plastic surfaces, the compositions of Examples 4 and 5 performed similarly to the composition of Comparative Example A at removing soils but did not perform as well as the composition of Comparative Example A at preventing redeposition of soils. However, the compositions of Examples 4 and 5 still performed at an acceptable level, having ratings of less than about 3.

Examples 7, 8, 9 and 10 and Comparative Example A

[0077] Examples 7, 8, 9 and 10 are compositions of the present invention with component concentrations (in weight percent) of sodium carbonate (soda ash or dense ash), sodium bicarbonate, mono ash, sodium metasilicate, a surfactant premix, potassium hydroxide (45%), water, sodium citrate dehydrate and various poly sugars, as provided in Table 5. The surfactant premix including the Dehypon LS-36 and Pluronic 25R2 were first mixed together before combining with the remainder of the components.

[0078] The compositions of Examples 7, 8, 9 and 10 included about 60 ppm of a poly sugar. In particular, the composition of Example 7 included inulin, the composition of Example 8 included potato starch, the composition of Example 9 included Sodium CMC and the composition of Example 10 included cyclodextrin.

[0079] The composition of Comparative Example A was prepared similarly to the compositions of Examples 7, 8, 9 and 10, except that the composition of Comparative Example A did not include a poly sugar.

[0080] Table 5 provides the component concentrations for the compositions of Examples 7, 8, 9 and 10 and Comparative Example A.

Table 5.

Component	Example 7 (wt%)	Example 8 (wt%)	Example 9 (wt%)	Example 10 (wt%)	Comp. Ex. A (wt%)
Dense Ash	61.19	61.19	61.19	61.19	60.66
Sodium bicarbonate	0.27	0.27	0.27	0.27	6.8
Mono Ash	12.95	12.95	12.95	12.95	12.95
Sodium metasilicate	3.16	3.16	3.16	3.16	3.16
Dehypon LS-36	3.53	3.53	3.53	3.53	3.53
Pluronic 25R2	1.06	1.06	1.06	1.06	1.06
KOH (45%)	2.08	2.08	2.08	2.08	2.08
Water	4	4	4	4	4
Sodium citrate dehydrate	5.76	5.76	5.76	5.76	5.76
Inulin	6	0	0	0	0
Potato Starch	0	6	0	0	0
Sodium CMC	0	0	6	0	0
Cyclodextrin	0	0	0	6	0

[0081] The compositions of Examples 7, 8, 9 and 10 and Comparative Example A were tested for soil removal and anti-redeposition properties according to the method described above. Table 6 provides the average visual ratings for the glass and plastic tumblers treated with the compositions of Examples 7, 8, 9 and 10 and Comparative Example A. Generally, an average rating of 3 or below, and particularly an average rating of 2 or below, is considered acceptable.

Table 6.

	Example 7	Example 8	Example 9	Example 10	Comp. Example A
Soil Removal					
Average Glass Rating	2.67	1.17	5	1	4.92
Average Plastic Rating	2.75	2.5	4.5	2.38	5
Redeposition					
Average Glass Rating	1	1	1	1	1.58
Average Plastic Rating	1	1	1	1	2.5

[0082] As can be see in Table 6, at about 60 ppm, the compositions including inulin (Example 7), potato starch (Example 8) and cyclodextrin (Example 10) were effective both at removing soils and preventing redeposition of soils onto glass and plastic surfaces. The compositions of Examples 7, 8, and 10 also outperformed the composition of Comparative Example A at all test conditions.

[0083] The composition of Example 9, which included sodium CMC, outperformed the composition of Comparative Example A at removing soils from plastic surfaces and preventing redeposition of soils from glass and plastic. Without being bound by theory, it is believed that poly sugars that are functionalized with substituents other than alcohol groups do not perform as well as poly sugars that are functionalized with alcohol groups.

<u>Examples 11 and 12 and Comparative Example A</u>

[0084] Examples 11 and 12 are compositions of the present invention with component concentrations (in weight percent) of sodium carbonate (soda ash or dense ash), sodium bicarbonate, mono ash, sodium metasilicate, a surfactant premix, potassium hydroxide (45%), water, sodium citrate dehydrate and various poly sugars, as provided in Table 5. The surfactant premix including the Dehypon LS-36 and Pluronic 25R2 were first mixed together before combining with the remainder of the components.

[0085] The compositions of Examples 11 and 12 included about 90 ppm of a poly sugar. In particular, the composition of Example 11 included potato starch and the composition of Example 12 included cyclodextrin.

[0086] The composition of Comparative Example A was prepared similarly to the compositions of Examples 11 and 12, except that the composition of Comparative Example A did not include a poly sugar.

[0087] Table 7 provides the component concentrations for the compositions of Examples 11 and 12 and Comparative Example A.

Table 7.

Component	Example 11 (wt%)	Example 12 (wt%)	Comp. Ex. A (wt%)
Dense Ash	61.19	61.19	60.66
Sodium bicarbonate	0.0	0.0	6.8
Mono Ash	10.22	10.22	12.95
Sodium metasilicate	3.16	3.16	3.16
Dehypon LS-36	3.53	3.53	3.53
Pluronic 25R2	1.06	1.06	1.06
KOH (45%)	2.08	2.08	2.08
Water	4	4	4
Sodium citrate dehydrate	5.76	5.76	5.76
Potato Starch	9	0	0
Cyclodextrin	0	9	0

[0088] The compositions of Examples 11 and 12 and Comparative Example A were tested for soil removal and anti-redeposition properties according to the method described above. Table 8 provides the average visual ratings for the glass and plastic tumblers treated with the compositions of Examples 11 and 12 and Comparative Example A. Generally, an average rating of 3 or below, and particularly an average rating of 2 or below, is considered acceptable.

Table 8.

	Example 11	Example 12	Comp. Example A
Soil Removal			
Average Glass Rating	1.21	1.50	4.92
Average Plastic Rating	2.25	2.125	5
Redeposition			
Average Glass Rating	1	1	1.58
Average Plastic Rating	1.25	1.25	2.5

[0089] As can be see in Table 8, at about 90 ppm, the compositions including potato starch (Example 11) and cyclodextrin (Example 12) were effective both at removing soils and preventing redeposition of soils onto glass and plastic surfaces. The compositions of Examples 11 and 12 also outperformed the composition of Comparative Example A at all test conditions.

Examples 13, 14, 15 and 16

[0090] Once it was determined that increasing the concentrations of poly sugars increased the ability of a cleaning composition to remove protein soil and prevent redeposition, various cleaning compositions were formed including a polymer. Because polymers are commonly used to control water hardness, the tests were designed to determine whether the polymers effected the performance of the poly sugars.

[0091] Examples 13, 14, 15 and 16 are compositions of the present invention with component concentrations (in weight percent) of sodium carbonate (soda ash or dense ash), sodium bicarbonate, mono ash, sodium metasilicate, a surfactant premix, potassium hydroxide (45%), water, sodium citrate dehydrate, Acusol 445ND and various poly sugars, as provided in Table 9. The surfactant premix including the Dehypon LS-36 and Pluronic 25R2 was first mixed together before combining with the remainder of the components.

[0092] The compositions of Examples 13, 14, 15 and 16 included a poly sugar. In particular, the compositions of Examples 13 and 14 included cyclodextrin and the compositions of Examples 15 and 16 included potato starch. The primary difference between the compositions of Examples 13 and 14 was that the composition of Example 13 included about 30 ppm of cyclodextrin and the composition of Example 14 included about 60 ppm of cyclodextrin. Likewise, the primary difference between the compositions of Examples 15 and 16 was that the composition of Example 15 included about 30 ppm of potato starch and the composition of Example 16 included about 60 ppm of potato starch. The amount of sodium bicarbonate in each of the compositions was fluctuated to accommodate the amount of poly sugar.

[0093] Table 9 provides the component concentrations for the compositions of Examples 13, 14, 15 and 16.

Table 9.

Component	Example 13 (wt%)	Example 14 (wt%)	Example 15 (wt%)	Example 16 (wt%)
Dense Ash	60.66	60.66	60.66	60.66
Sodium bicarbonate	3.8	0.8	3.8	0.8
Mono Ash	12.95	12.95	12.95	12.95
Sodium metasilicate	3.16	3.16	3.16	3.16
Dehypon LS-36	3.53	3.53	3.53	3.53
Pluronic 25R2	1.06	1.06	1.06	1.06
KOH (45%)	2.08	2.08	2.08	2.08
Water	4	4	4	4
Sodium citrate dehydrate	3.26	3.26	3.26	3.26
Acusol 445ND	2.5	2.5	2.5	2.5
Cyclodextrin	3	6	0	0
Potato Starch	0	0	3	6

[0094] The compositions of Examples 13, 14, 15 and 16 were tested for soil removal and anti-redeposition properties according to the method described above. Table 10 provides the average visual ratings for the glass and plastic tumblers treated with the compositions of Examples 13, 14, 15 and 16. Generally, an average rating of 3 or below, and particularly an average rating of 2 or below, is considered acceptable.

Table 10.

	Example 13	Example 14	Example 15	Example 16
Soil Removal				
Average Glass Rating	2.88	2.75	2.92	3.83
Average Plastic Rating	3.25	3.25	3.25	3.75

Redeposition				
Average Glass Rating	1	1	1	1
Average Plastic Rating	1	1	1	1

[0095] As can be seen in Table 10, compositions including about 30 ppm and about 60 ppm of cyclodextrin (Examples 13 and 14) had acceptable visual ratings for removing protein soils from glass.

[0096] At 30 ppm, potato starch (Example 15) also resulted in an acceptable visual rating for removing protein soils from glass. As can be seen in Table 10, the potato starch did not remove as much soil from both glass and plastic at 60 ppm (Examples 15 and 16, respectively).

[0097] The compositions of Examples 13, 14, 15 and 16 all had acceptable visual ratings for preventing redeposition of soils on both glass and plastic surfaces.

Examples 17, 18, 19, 20, 21 and 22

[0098] To further test the affect of whether the addition of polymer effected the ability of poly sugars to remove protein soil and prevent redeposition, various compositions were formed.

[0099] Examples 17, 18, 19, 20, 21 and 22 are compositions of the present invention with component concentrations (in weight percent) of sodium carbonate (soda ash or dense ash), sodium bicarbonate, mono ash, sodium metasilicate, a surfactant premix, potassium hydroxide (45%), water, sodium citrate dehydrate, Acusol 445ND and various poly sugars, as provided in Table 9. The surfactant premix including the Dehypon LS-36 and Pluronic 25R2 were first mixed together before combining with the remainder of the components.

[00100] The compositions of Examples 17, 18, 19, 20, 21 and 22 included a poly sugar. In particular, the compositions of Examples 17, 18 and 19 included cyclodextrin and the compositions of Examples 20, 21 and 22 included potato starch. The primary difference among the compositions of Examples 17, 18 and 19 was that the composition of Example 17 included about 30 ppm of cyclodextrin, the composition of Example 18 included about 60 ppm of cyclodextrin, and the composition of Example 19 included about 90 ppm of cyclodextrin. Likewise, the primary difference among the compositions of Examples 20, 21 and 22 was that the composition of Example 20 included about 30 ppm of potato starch, the composition of Example 21 included about 60 ppm of potato starch, and the composition of Example 22 included about 60 ppm of potato starch. The amount of sodium bicarbonate, mono ask and Acusol 445ND in each of the compositions were fluctuated to accommodate the amount of poly sugar.

[00101] Table 11 provides the component concentrations for the compositions of Examples 17, 18, 19, 20, 21 and 22.

Table 11.

Component	Example 17 (wt%)	Example 18 (wt%)	Example 19 (wt%)	Example 20 (wt%)	Example 21 (wt%)	Example 22 (wt%)
Dense Ash	60.66	60.66	60.66	60.66	60.66	60.66
Sodium bicarbonate	1.3	2.3	0.8	1.3	2.3	0.8
Mono Ash	12.95	12.95	9.95	12.95	12.95	9.95
Sodium metasilicate	3.16	3.16	3.16	3.16	3.16	3.16
Dehypon LS-36	3.53	3.53	3.53	3.53	3.53	3.53
Pluronic 25R2	1.06	1.06	1.06	1.06	1.06	1.06
KOH (45%)	2.08	2.08	2.08	2.08	2.08	2.08
Water	4	4	4	4	4	4
Sodium citrate dehydrate	3.26	3.26	3.26	3.26	3.26	3.26
Acusol 445ND	5	1	2.5	5	1	2.5
Cyclodextrin	3	6	9	0	0	0
Potato Starch	0	0	0	3	6	9

[00102] The compositions of Examples 17, 18, 19, 20, 21 and 22 were tested for soil removal and anti-redeposition properties according to the method described above. Table 12 provides the average visual ratings for the glass and plastic tumblers treated with the compositions of Examples 17, 18, 19, 20, 21 and 22. Generally, an average rating of 3 or below, and particularly an average rating of 2 or below, is considered acceptable.

Table 12.

	Example 17	Example 18	Example 19	Example 20	Example 21	Example 22
Soil Removal						
Average Glass Rating	3.33	2.17	3.58	1.58	2.33	3.58
Average Plastic Rating	2.25	2.5	2.15	3.5	3.25	2.25
Redeposition						
Average Glass Rating	1	1	1	1	1	1
Average Plastic Rating	1	2	1.75	1.625	1	1.5

[00103] Table 12 shows that all of the compositions of Examples 17, 18, 19, 20, 21 and 22 had acceptable visual ratings for preventing the redeposition of soils on both glass and plastic surfaces.

[00104] The compositions including a polymer in combination with about 30 ppm, about 60 ppm and about 90 ppm of cyclodextrin (Examples 17, 18 and 19, respectively) did not affect the ability of the poly sugar to remove protein soil from plastic or to prevent the redeposition of protein soil from glass or plastic. In particular, the compositions of Examples 17, 18 and 19 had acceptable visual ratings for removing protein soils from glass and plastic.

[00105] While the ability to remove soil from glass decreased as the amount of potato starch increased from the composition of Example 20 to the composition Example 22, the ability to remove soil from plastic increased to an acceptable level.

Residual Water

[00106] After determining that poly sugars are effective at removing/preventing redeposition of proteins on hard surfaces such as glass and plastic, a series of runs were carried out to determine the amount of residual water left on ware washed with the cleaning compositions of the present invention. After washing with the cleaning compositions of the present invention, the ware was rinsed with rinse water that either included or excluded a rinse aid in the rinse water. The tests were run to see whether the presence of a rinse aid made a significant difference in the amount of residual water left on the ware. Each test was duplicated to ensure reproducibility. RO Free and Ultra Dry Rinse Aids are rinse aids available from Ecolab, Inc., St. Paul, MN.

[00107] A Hobart AM-14 warewash machine with the following specifications was used: washbath volume of 60 liters, rinse volume of 4.5 liters, wash time of 40 seconds and rinse time of 9 seconds.

[00108] The warewash machine was first filled with 5 GPG water. The tank heaters were turned on and wash/rinse cycles were run on the warewash machine until a wash temperature of between about 150 and about 160°F and a rinse temperature of between about 175 and about 190°F were reached. The warewash machine was charged with 1000 ppm cleaning composition and one cycle was run to dissolve the cleaning composition completely. For applicable experiments, it was verified that the rinse aid was interfaced to the warewash machine.

[00109] The concentration of rinse aid used for each experiment was 2 mL. Each container was weighed and placed in a rack inside the warewash machine (see figure below for arrangement). G = glass tumblers, P = plastic tumblers, M=Metal beakers.

					M6
				P5	
			G4		
		M3			
	P2				
G1					

[00110] One wash/rinse cycle was then run. The glasses were removed from the warewash machine and reweighed about 30 seconds after being removed from the warewash machine. The amount of residual water was calculated from the following equation:

> weight of container after one cycle – weight of container prior to one cycle = mass of residual water after 1 cycle.

Examples 23, 24 and 25

[00111] The compositions of Examples 23, 24 and 25 are compositions of the present invention and include a poly sugar. In particular, the compositions of Examples 23, 24 and 25 included 3% cyclodextrin.

[00112] The ware washed with the composition of Example 23 was rinsed with only rinse water. The ware washed with the compositions of Examples 24 and 25 were rinsed with a rinse water including a rinse aid. In particular, the ware washed with the composition of Example 24 was rinsed with RO Free Rinse Aid and the ware washed with the composition of Example 25 was rinsed with Ultra Dry Rinse Aid.

[00113] The compositions of Examples 23, 24 and 25 were tested to determine the amount of residual water remaining after washing according to the method described above. Table 13 provides the individual, total and average residual water remaining and standard deviation for the compositions of Examples 23, 24 and 25. Each composition and rinse aid combination was run two times.

Table 13.

		G1	P2	M3	G4	P5	M6	Total Residual Water (g)	AVG	Std. Dev.
Ex. 23	3% cyclodextrin w/o rinse aid	0.58	0.34	0.36	0.29	0.26	0.36	2.19	2.05	0.19799
		0.57	0.11	0.25	0.29	0.27	0.42	1.91		
Ex. 24	3% cyclodextrin w/ RO Free Rinse Aid	0.46	0.11	0.27	0.32	0.22	0.31	1.69	1.62	0.09899
		0.38	0.12	0.38	0.34	0.14	0.19	1.55		
Ex. 25	3% cyclodextrin w/ Ultra Dry Rinse Aid	0.4	0.14	0.22	0.17	0.27	0.33	1.53	1.5	0.04243
		0.26	0.13	0.23	0.19	0.33	0.33	1.47		

[00114] The results shown above in Table 13 indicate that the amount of residual water is significantly reduced when a rinse aid is used during the rinse step. In particular, the amount of residual water decreased on average by about 20% when RO Free Rinse Aid (Example 24) was added and on average by over 25% when Ultra Dry Rinse Aid was added (Example 25).

Examples 26, 27 and 28

[00115] The compositions of Examples 26, 27 and 28 are compositions of the present invention and include a poly sugar. In particular, the compositions of Examples 26, 27 and 28 included 3% inulin.

[00116] The ware washed with the composition of Example 26 was rinsed with only rinse water. The ware washed with the compositions of Examples 27 and 28 were rinsed with a rinse water including a rinse aid. In particular, the ware washed with the composition of Example 27 was rinsed with RO Free Rinse Aid and the ware washed with the composition of Example 28 was rinsed with Ultra Dry Rinse Aid.

[00117] The compositions of Examples 26, 27 and 28 were tested to determine the amount of residual water remaining after washing according to the method described above. Table 14 provides the drying times and total residual water remaining for Examples 26, 27 and 28. Each composition and rinse aid combination was run two times.

Table 14.

		G1	P2	M3	G4	P5	M6	Total Residual Water (g)	AVG	Std. Dev.
Ex. 26	3% inulin w/o rinse aid	0.39	0.29	0.44	0.4	0.25	0.62	2.39	2.275	0.16263
		0.55	0.53	0.17	0.17	0.32	0.42	2.16		
Ex. 27	3% inulin w/ RO Free Rinse Aid	0.54	0.11	0.26	0.3	0.25	0.17	1.63	1.65	0.02828
		0.47	0.16	0.26	0.33	0.22	0.23	1.67		
Ex. 28	3% inulin w/ Ultra Dry Rinse Aid	0.44	0.13	0.22	0.17	0.13	0.3	1.39	1.41	0.02828
		0.41	0.13	0.27	0.32	0.12	0.18	1.43		

[00118] Table 14 shows that the amount of residual water remaining on ware is significantly reduced when a rinse aid is used during the rinse step. In particular, the amount of residual water decreased on average by over 27% when RO Free Rinse Aid (Example 27) was added and on average by about 38% when Ultra Dry Rinse Aid was added (Example 28).

[00119] Various modifications and additions can be made to the exemplary embodiments discussed without departing from the scope of the present invention. For example, while the embodiments described above refer to particular features, the scope of this invention also includes embodiments having different combinations of features and embodiments that do not include all of the above described features.

CLAIMS

The following is claimed:

1. A method of removing protein soils from a surface of a substrate and preventing redeposition of protein soils onto the surface of the substrate, the method comprising:

(a) introducing a protein-removing/anti-redeposition agent during a washing step of a wash cycle, wherein the protein-removing/anti-redeposition agent comprises a poly sugar;

(b) introducing a cleaning composition during the washing step of the wash cycle, wherein the cleaning composition comprises an alkalinity source;

(c) washing the surface of the substrate with the protein-removing/anti-redeposition agent and the cleaning composition during the wash cycle; and

(d) subsequently rinsing the surface of the substrate with a rinse aid.

2. The method of claim 1, wherein the surface is one of glass, ceramic, metal and plastic.

3. The method of claim 1, wherein the poly sugar comprises at least one of one of: inulin, carboxymethyl inulin, potato starch, sodium carboxymethylcellulose, linear sulfonated α-(1,4)-linked D-glucose polymers and γ-cyclodextrin.

4. The method of claim 1, wherein the cleaning composition further comprises a surfactant component constituting up to about 15% by weight of the cleaning composition.

5. The method of claim 1, wherein introducing the protein-removing/anti-redeposition agent and cleaning composition occur simultaneously.

6. The method of claim 1, wherein introducing the protein-removing/anti-redeposition agent and cleaning composition occur as separate steps.

7. The method of claim 1, wherein the cleaning composition is substantially free of alkali earth metals.

8. The method of claim 1, wherein the cleaning composition is substantially free of phosphorus-containing compounds.

9. The method of claim 1, wherein the protein-removing/anti-redeposition agent constitutes between about 0.1% and about 85% by weight of the cleaning composition.

10. A method of removing protein soil and preventing redeposition of soils, the composition comprising:

(a) introducing a cleaning composition during the washing step of a wash cycle, wherein the cleaning composition comprises between about 1% and about 90% by weight poly sugar, between about 1% and about 80% by weight alkalinity source, between about 1% and about 10% by weight surfactant component and less than about 0.05% by weight alkali earth metals; and

(b) introducing a rinse aid during the rinsing step of the wash cycle.

11. The method of claim 10, wherein the poly sugar is at least one of: amylose, amylopectin, pectin, inulin, modified inulin, potato starch, modified potato starch, corn starch, modified corn starch, wheat starch, modified wheat starch, rice starch, modified rice starch, cellulose, modified cellulose, dextrin, dextran, maltodextrin, cyclodextrin, glycogen and oligiofructose

12. The method of claim 11, wherein the poly sugar is at least one of: inulin, carboxymethyl inulin, potato starch, sodium carboxymethylcellulose, linear sulfonated α-(1,4)-linked D-glucose polymers and γ-cyclodextrin.

13. The method of claim 10, wherein the cleaning composition comprises between about 1% and about 60% by weight poly sugar.

14. The method of claim 10, wherein the cleaning composition comprises between about 1% and about 40% by weight poly sugar.

15. The method of claim 10, wherein the cleaning composition is substantially free of phosphorus-containing compounds.

16. A cleaning system comprising:

(a) a detergent comprising a poly sugar, an alkalinity source, a surfactant component and water, wherein a 0.05 to 0.25% solution of the detergent has a pH of between about 10 and about 12.5; and

(b) a rinse aid.

17. The detergent of claim 16, further comprising a builder.

18. The detergent of claim 16, further comprising filler.

19. The detergent of claim 16, wherein the poly sugar comprises at least one of: amylose, amylopectin, pectin, inulin, modified inulin, potato starch, modified potato starch, corn starch, modified corn starch, wheat starch, modified wheat starch, rice starch, modified rice starch, cellulose, modified cellulose, dextrin, dextran, maltodextrin, cyclodextrin, glycogen and oligiofructose, carboxymethyl inulin and linear sulfonated α-(1,4)-linked D-glucose polymers.

20. The detergent of claim 16, wherein the detergent is substantially free of phosphorus-containing compounds.