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(54) **WATER SOLUBLE MAGNESIUM COMPOUNDS AS CLEANING AGENTS AND METHODS OF USING THEM**

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(57) **ABSTRACT**

The present invention relates to compositions and methods employing a water soluble magnesium compound. In certain embodiments, the composition includes water and water soluble magnesium compound, but lacks other materials commonly used in cleaning compositions. The methods and compositions can provide magnesium ion at predefined ratios to calcium ion in water, such as magnesium ion in a molar amount equal to or in excess over a molar amount of calcium ion. A water soluble magnesium salt including an anion of a water soluble calcium salt is more effective than a magnesium salt with an anion of a water insoluble calcium salt. These compositions can be used for reducing lime scale or precipitate formation from hard water, removing soap scum, or the like.

Figure 1

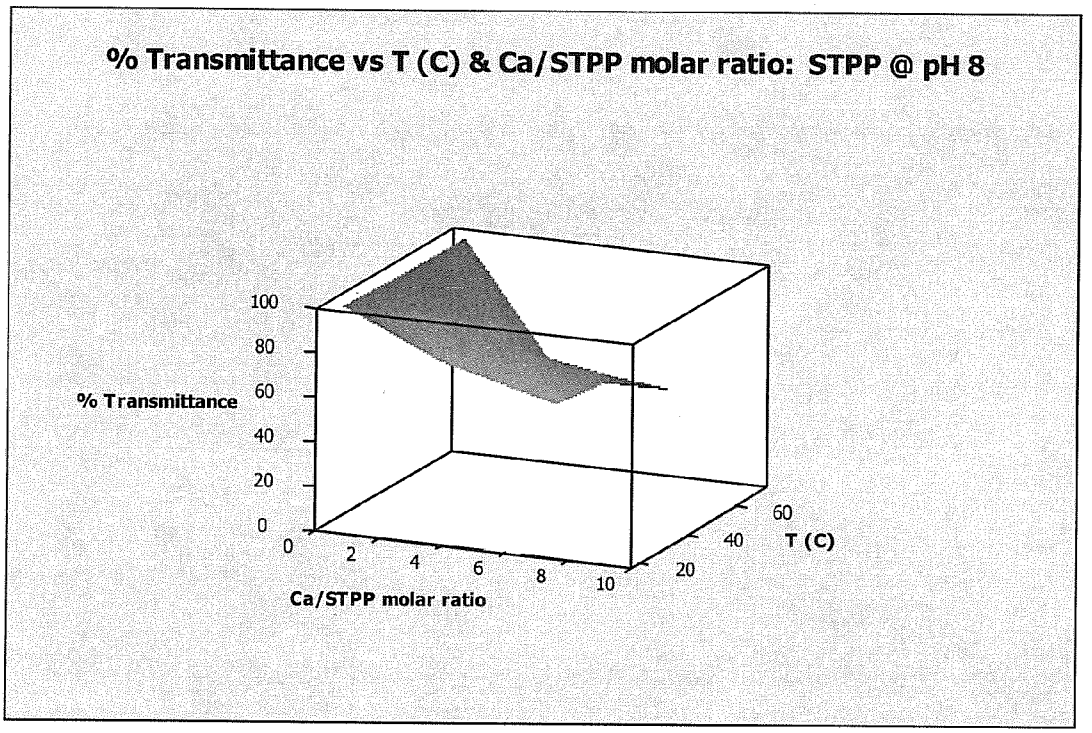

% Transmittance vs T (C) & Ca/STPP molar ratio: STPP @ pH 8
% Transmittance
100
80
60
40
20
0
0
2
4
6
8
10
Ca/STPP molar ratio
20
40
60
T (C)

Figure 2

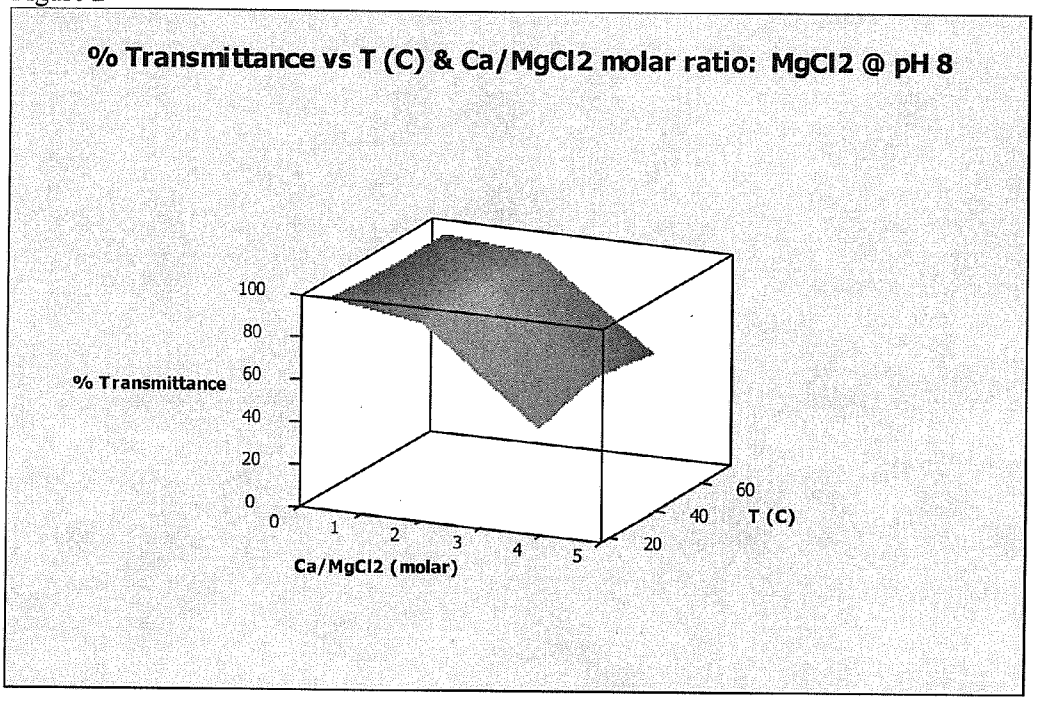

% Transmittance vs T (C) & Ca/MgCl2 molar ratio: MgCl2 @ pH 8
% Transmittance
100
80
60
40
20
0
0
1
2
3
4
5
Ca/MgCl2 (molar)
20
40
60
T (C)

Figure 3

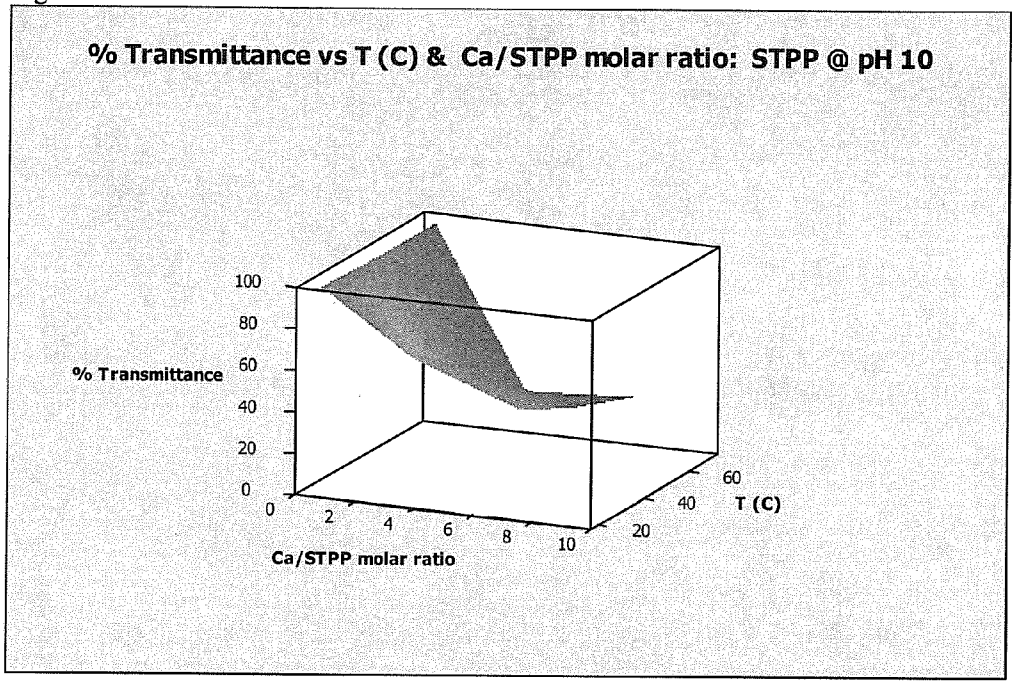

% Transmittance vs T (C) & Ca/STPP molar ratio: STPP @ pH 10
% Transmittance
100
80
60
40
20
0
0
2
4
6
8
10
Ca/STPP molar ratio
20
40
60
T (C)

Figure 4

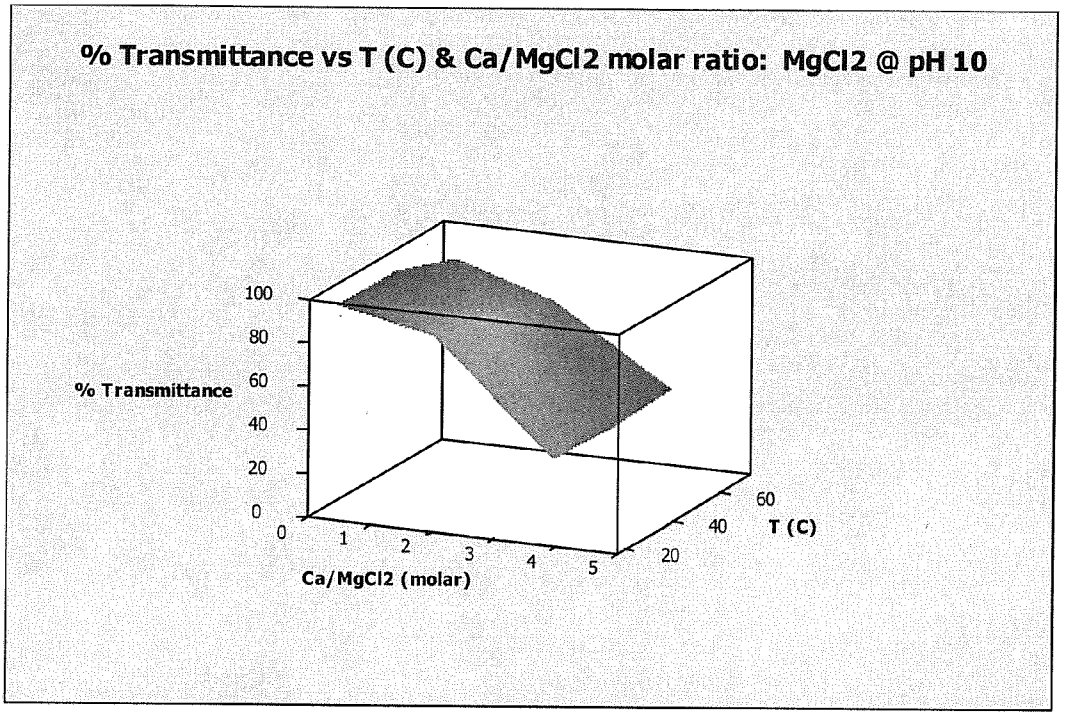

% Transmittance vs T (C) & Ca/MgCl2 molar ratio: MgCl2 @ pH 10
% Transmittance
100
80
60
40
20
0
0
1
2
3
4
5
Ca/MgCl2 (molar)
20
40
60
T (C)

Figure 5

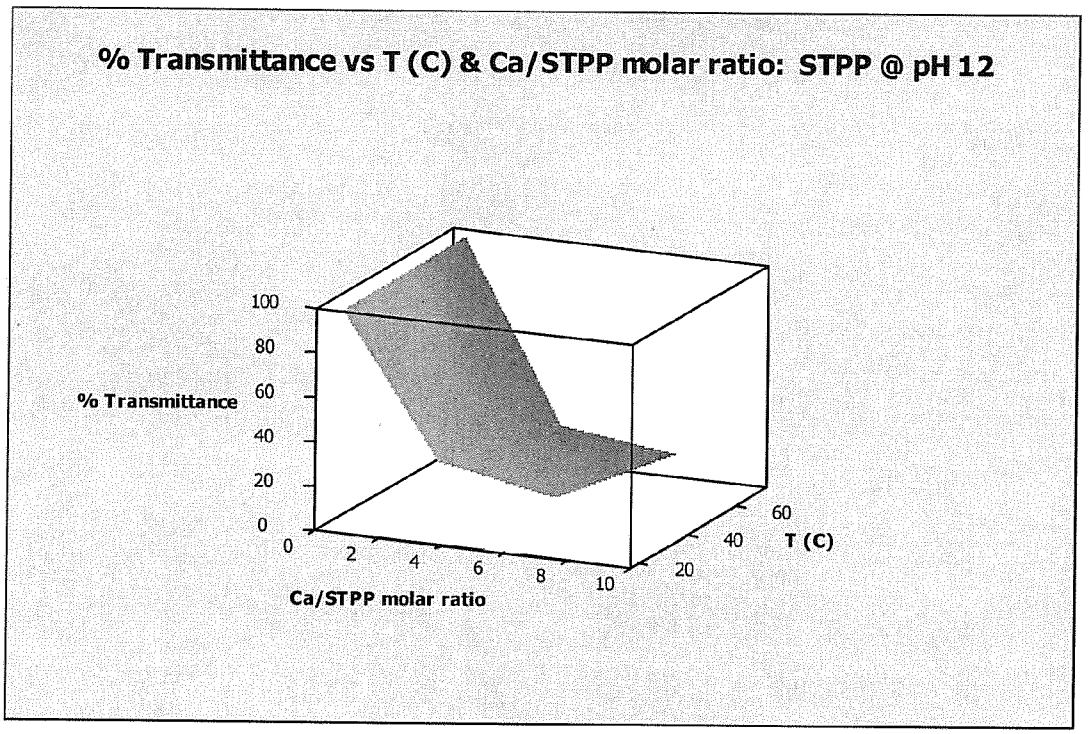

% Transmittance vs T (C) & Ca/STPP molar ratio: STPP @ pH 12
% Transmittance
100
80
60
40
20
0
0
2
4
6
8
10
Ca/STPP molar ratio
20
40
60
T (C)

Figure 6

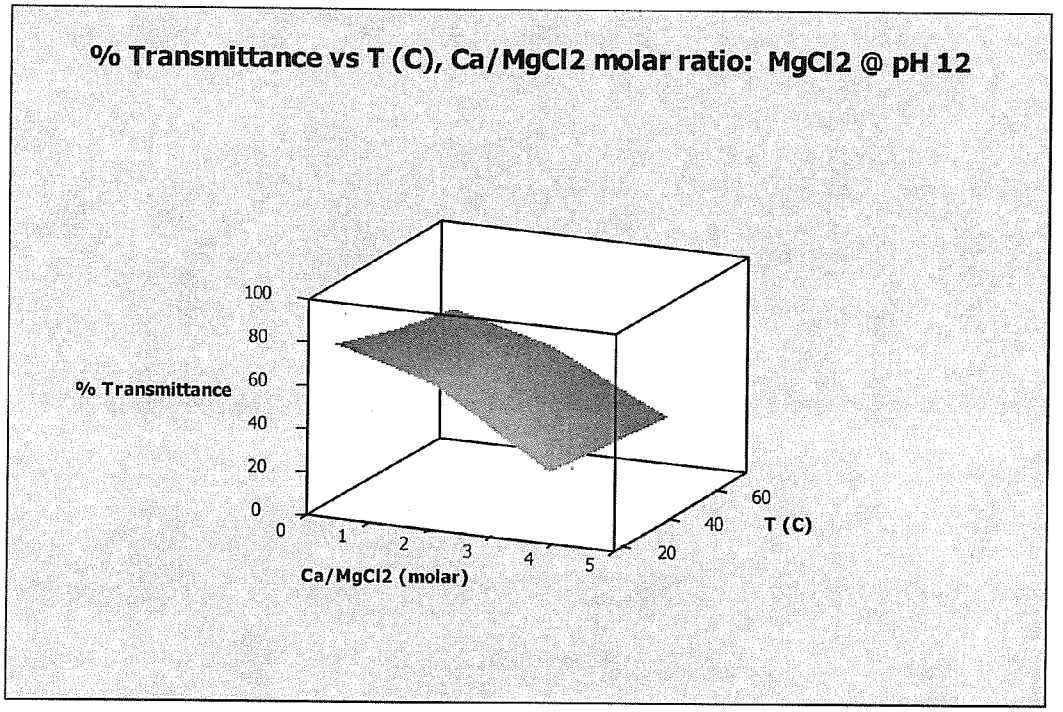

% Transmittance vs T (C), Ca/MgCl2 molar ratio: MgCl2 @ pH 12
% Transmittance
100
80
60
40
20
0
0
1
2
3
4
5
Ca/MgCl2 (molar)
20
40
60
T (C)

Fig. 7

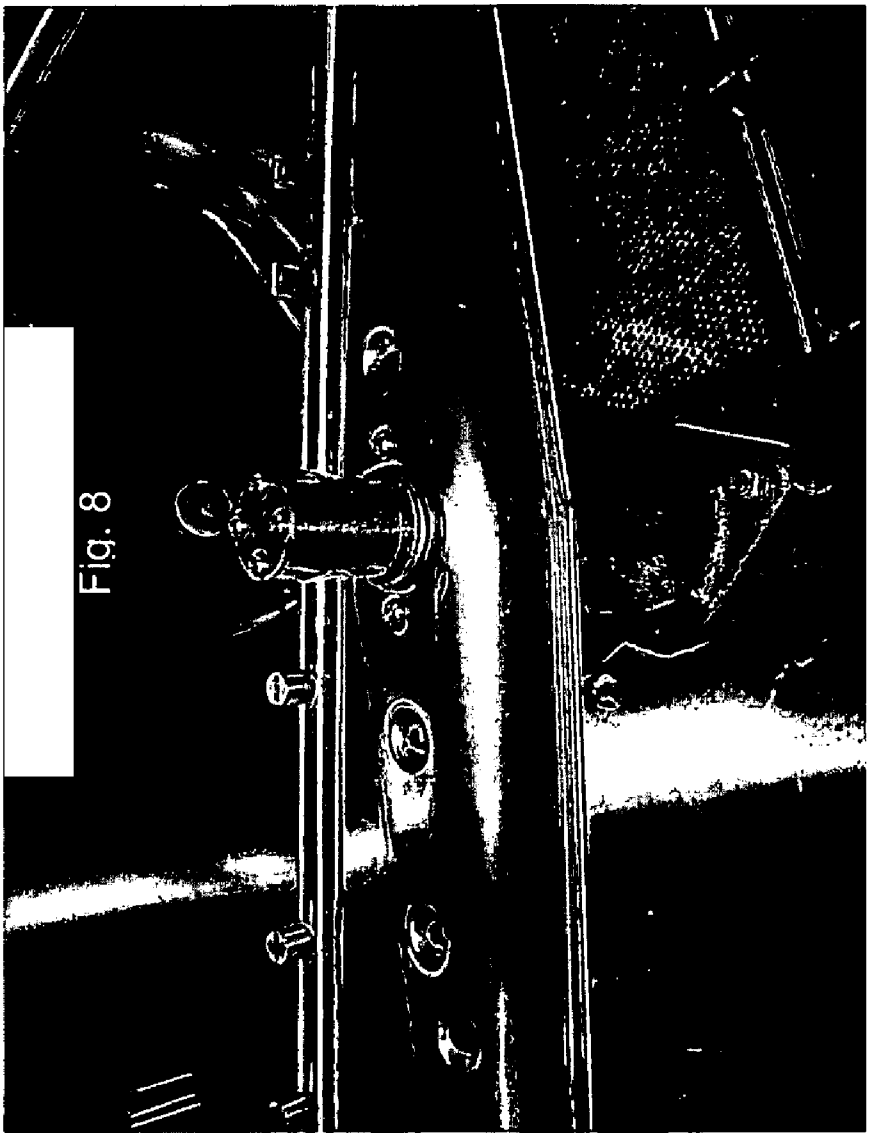


Fig. 8

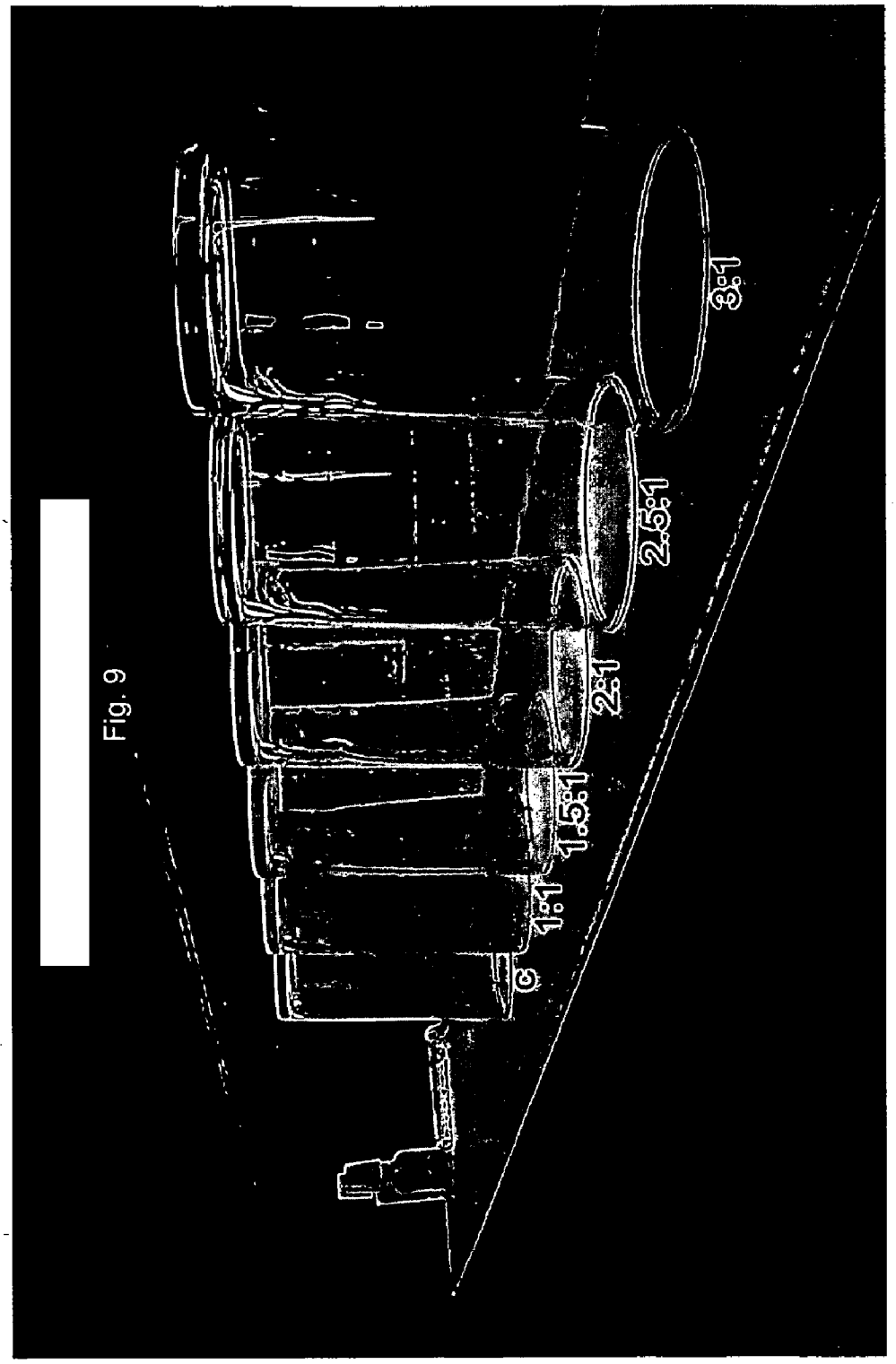


Fig. 9

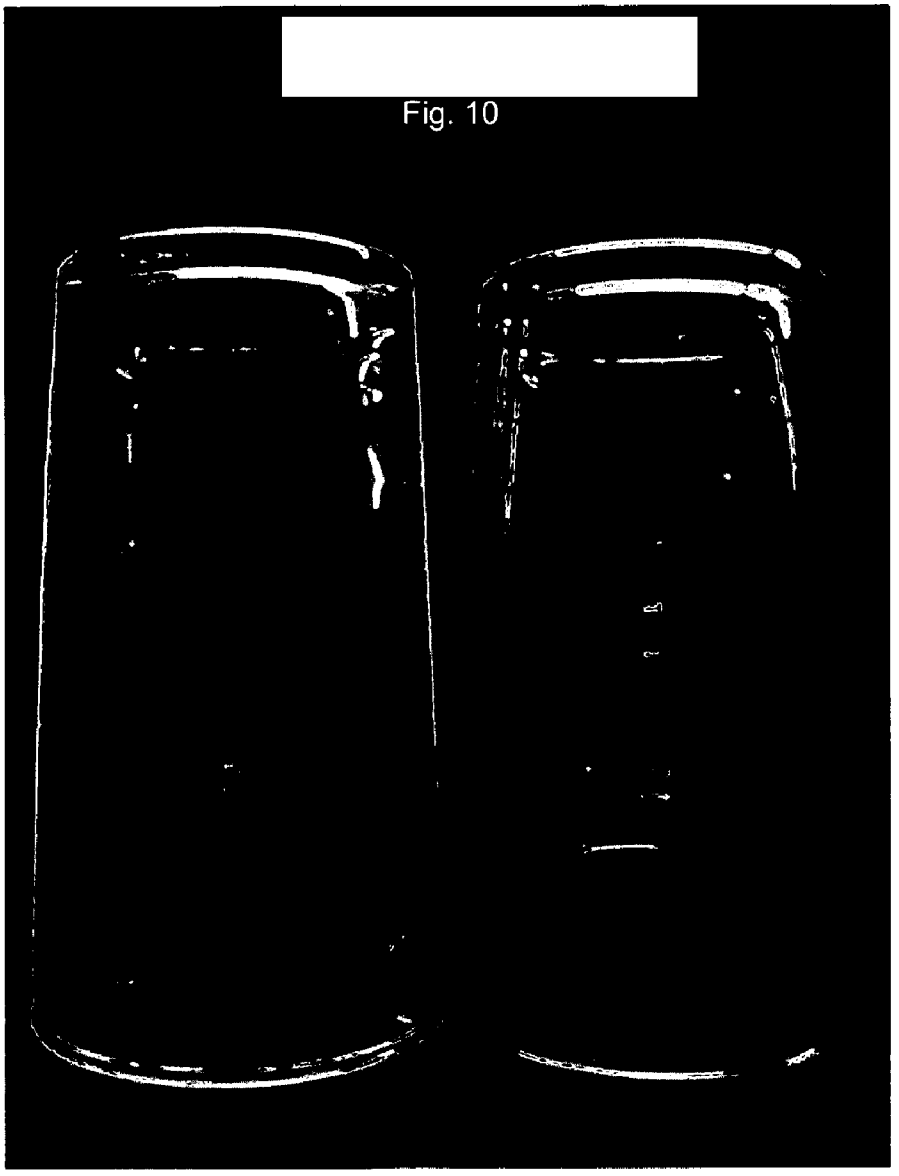
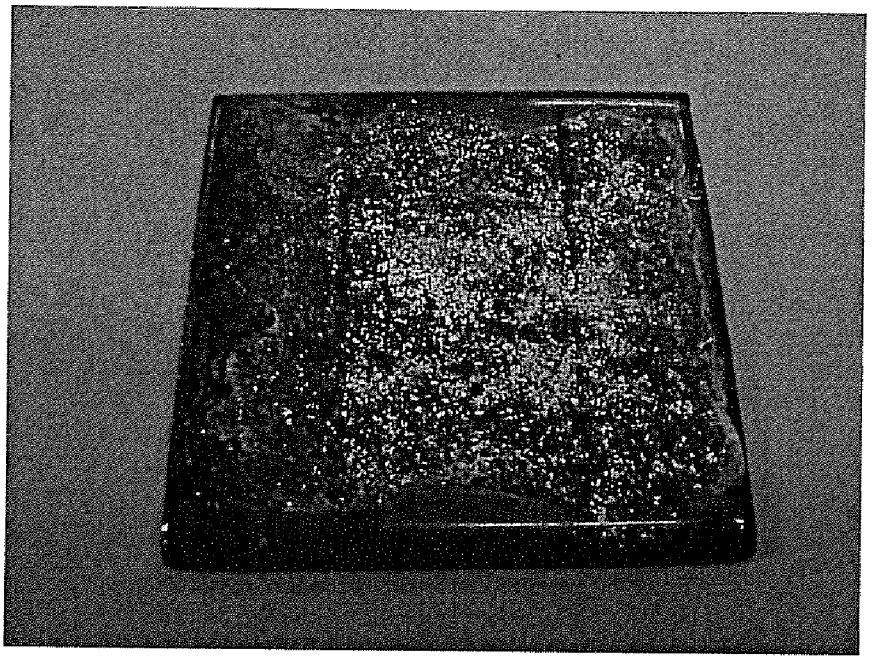


Fig. 10

Figure 11



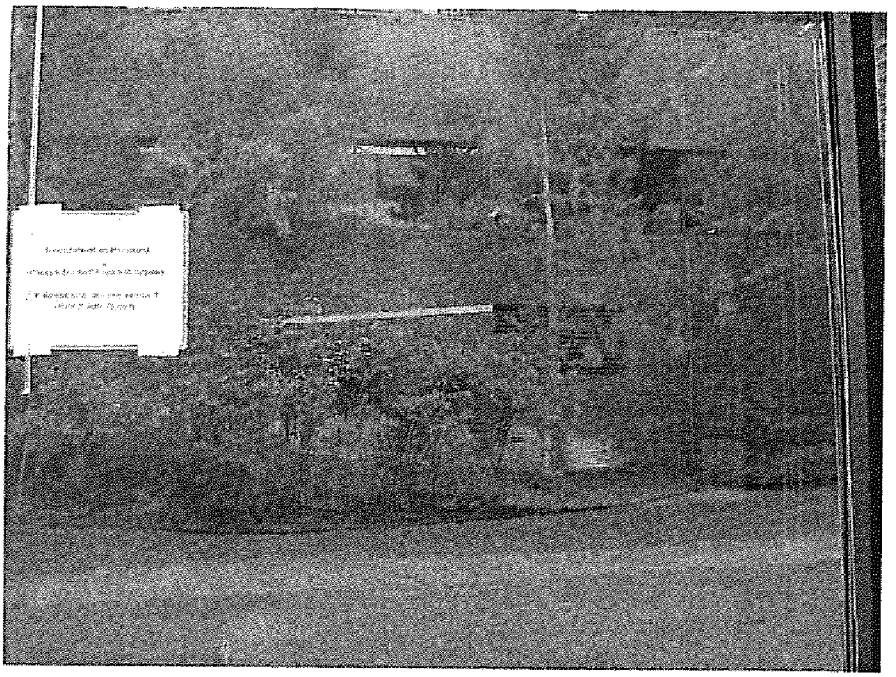


Figure 12

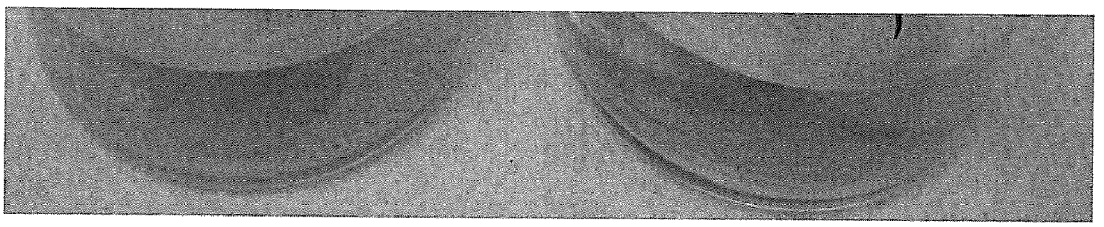


Figure 13

WATER SOLUBLE MAGNESIUM COMPOUNDS AS CLEANING AGENTS AND METHODS OF USING THEM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to U.S. Provisional Application Ser. No. 60/927,575 filed on May 4, 2007 and entitled "Compositions Containing Magnesium Salt and Methods of Using", the disclosure of which is incorporated herein by reference.

[0002] This application is also related to: U.S. patent application Ser. No. _____, entitled "Cleaning Compositions with Water Insoluble Conversion Agents and Methods of Making and Using Them" (Attorney Docket No. 2454USU1); U.S. patent application Ser. No. _____, entitled, "In Situ Generation of Nanoparticles Under Alkaline Conditions" (Attorney Docket No. 2437USU1); U.S. patent application Ser. No. _____, entitled "Water Treatment System and Downstream Cleaning Methods" (Attorney Docket No. 2428USU1); U.S. patent application Ser. No. _____, entitled "Cleaning Compositions Containing Water Soluble Magnesium Compounds and Methods of Using Them" (Attorney Docket No. 2488USU1); U.S. patent application Ser. No. _____, entitled "MG++ Chemistry and Method for Fouling Inhibition in Heat Processing of Liquid Foods and Industrial Processes" (Attorney Docket No. 2400USU1); U.S. patent application Ser. No. _____, entitled "Compositions Including Hardness Ion and Gluconate and Methods Employing Them to Reduce Corrosion and Etch" (Attorney Docket No. 163.2365USU1); U.S. patent application Ser. No. _____, entitled "Compositions Including Hardness Ion and Silicate and Methods Employing Them to Reduce Corrosion and Etch" (Attorney Docket No. 163.2487USU1); U.S. patent application Ser. No. _____, entitled "Compositions Including Hardness Ion and Threshold Agent and Methods Employing Them to Reduce Corrosion and Etch" (Attorney Docket No. 163.2406USU1); and U.S. patent application Ser. No. _____, entitled "Warewashing Compositions for Use in Automatic Dishwashing Machines and Method for Using" (Attorney Docket No. 2378USU1), all commonly assigned to Ecolab, Inc., are filed on the same date as this application being May 2, 2008 and are all incorporated herein by reference for all purposes.

FIELD OF THE INVENTION

[0003] The present invention relates to compositions and methods employing a water soluble magnesium compound. The present invention is useful, among other things, in preparing a presoak or prewash agent, a cleaning composition, or a rinse agent particularly for hard surfaces. The invention also relates to methods of using such compositions to reduce lime sale, remove soap scum, reduce hard water spotting and the like. In certain embodiments, the composition includes water and water soluble magnesium compound, but lacks other materials commonly used in cleaning compositions. The methods and compositions can provide magnesium ion at predefined ratios to calcium ion in water, such as magnesium ion in a molar amount equal to or in excess over a molar amount of calcium ion. A water soluble magnesium salt including an anion of a water soluble calcium salt is more effective than a magnesium salt with an anion of a water insoluble calcium salt.

BACKGROUND OF THE INVENTION

[0004] The level of hardness in water can have undesirable effects in many systems. For example, when hard water is used in conjunction with cleaning compositions, hard water can cause precipitation of hard water scale or components of a cleaning agent. In general, hard water refers to water having a level of calcium and magnesium ions in excess of about 100 ppm expressed in units of ppm calcium carbonate.

[0005] Conventional methods add ingredients to hard water to overcome the undesirable effects of hard water. Water softeners add sodium ion to replace calcium and magnesium ions in hard water. Conventional cleaning compositions include builders like chelating agents, sequestrants, or threshold agents to tie up calcium and magnesium ions in the hard water. A great deal of effort has gone into developing new and better builders. Over the decades, a great deal of effort has gone into making more and more complicated detergent formulations in an attempt to provide desired performance in hard water.

[0006] It is unexpected that going in the opposite direction from the rest of the field to make a simpler composition could overcome the undesirable effects of hard water. Even more so, it is entirely unexpected that a simpler composition including added hardness ion would have a beneficial effect on lime scale or precipitate formation from hard water, removing soap scum, or the like.

SUMMARY OF THE INVENTION

[0007] The present invention departs from generally held beliefs that complicated formulae are necessary to overcome the deleterious and undesirable effects associated with hard water. When cleaning or rinsing hard surfaces, the use of hard water often results in hard water spotting, filming, staining, or soap scum left on the surface. Hard water spotting, staining, filming, and scale are particularly apparent when washing dishes in an automatic warewashing machine, cleaning basins or countertops or other hard surfaces in a kitchen or bathroom, or when washing vehicles. The present invention includes simpler compositions that overcome the stated undesirable effects of hard water. The present invention comprises methods and compositions employing a water soluble magnesium salt to counter the undesirable effects of calcium ion in hard water. In fact, one embodiment of the present methods and compositions employ nothing more than water soluble magnesium salt and hard water to this end. The present compositions and methods can reduce or prevent the formation of lime scale along with other deleterious effects associated with the use of hard water for cleaning hard surfaces. The present invention may be used to prepare presoaks or prewashes, cleaning agents, or rinse agents. The present invention relates to compositions and methods employing a water soluble magnesium compound. In certain embodiments, the composition includes water and water soluble magnesium compound, but lacks other materials commonly used in cleaning compositions. The methods and compositions can provide magnesium ion at predefined ratios to calcium ion in water, such as magnesium ion in a molar amount equal to or in excess over a molar amount of calcium ion. The water soluble magnesium salt has an associated anion that can exchange

with the carbonate associated with the calcium ion. It is preferred that the calcium anion product has the highest possible solubility, but is not required. These compositions can be used for reducing lime scale or precipitate formation from hard water, removing soap scum, or the like.

[0008] In another embodiment, the present invention includes a method of cleaning an object. This method can also reduce hard water spotting, scaling, or deposits. The method can include contacting the object with an aqueous composition including water and a water soluble magnesium salt; and recovering the object with an acceptable amount of hard water spotting, scaling, or deposits. In this method, the aqueous composition during contacting can include magnesium ion in a molar amount equal to or in excess over a molar amount of calcium ion. In this method, it is preferred that the water soluble magnesium salt can include an anion that forms a water soluble salt with calcium.

[0009] In another embodiment, the present invention includes a method of removing soap scum from an object. This method can include contacting the soap scum on the object with an aqueous composition of water and a water soluble magnesium salt; and removing soap scum from the object. In this method, the aqueous composition during contacting can include magnesium ion in a molar amount equal to or in excess over a molar amount of calcium ion. In this method, it is preferred that the water soluble magnesium salt can include an anion that, together with calcium ion, forms a water soluble calcium salt.

[0010] In yet another embodiment, the present invention includes a method of preventing or reducing the deposit of soap scum on an object. This method can include contacting the object with an aqueous composition of water and a water soluble magnesium salt. In this method, the aqueous composition during contacting can include magnesium ion in a molar amount equal to or in excess over a molar amount of calcium ion. In this method, it is preferred that the water soluble magnesium salt can include an anion that, together with calcium ion, forms a water soluble calcium salt.

[0011] In another embodiment, the present invention includes an aqueous composition of water and a water soluble magnesium salt. The present invention includes an aqueous composition consisting essentially of water and a water soluble magnesium salt. Upon dilution for use this composition can include magnesium ion in a molar amount equal to or in excess over the molar amount of calcium ion. A preferred composition can include water soluble magnesium salt including an anion that, together with calcium ion, forms a water soluble calcium salt.

[0012] The present invention includes in another embodiment a composition including a water soluble magnesium salt and a further ingredient selected from the group consisting of water antimicrobial agent, viscosity modifier, aesthetic enhancing agent, lubricant, dispersant, preservative, thickener, or mixture thereof. In an embodiment, the present invention includes a composition consisting essentially of a water soluble magnesium salt and the further ingredient. Upon dilution for use this composition can include magnesium ion in a molar amount equal to or in excess over the molar amount of calcium ion. A preferred composition can include water soluble magnesium salt can include an anion that, together with calcium ion, forms a water soluble calcium salt.

BRIEF DESCRIPTION OF THE FIGURES

[0013] FIGS. **1-6** each have an x, y, and z axis. The x-axis is a measure of the molar ratio of calcium to builder, e.g., STPP, or water soluble magnesium compound. The y-axis is a measure of the level of light transmittance thru the samples with 0% being no light transmitted and 100% being the entire beam of light transmitted. Full or partial loss of transmittance occurs as a consequence of the presence of particulate formation in the initially clear samples. An effective builder prevents or reduces precipitation resulting in a clear sample. The z-axis is a measure of the test temperature, ranging from 20-60° C.

[0014] FIG. **1** is a comparative plot illustrating the performance of STPP as a builder in the presence of various levels of calcium, at various temperatures, and at a constant pH of 8.

[0015] FIG. **2** is a plot of the performance of magnesium chloride in preventing precipitation in the presence of various levels of calcium, at various temperatures, and at a constant pH of 8.

[0016] FIG. **3** is a comparative plot illustrating the performance of STPP as a builder in the presence of various levels of calcium, at various temperatures, and at a constant pH of 10.

[0017] FIG. **4** is a plot of the performance of magnesium chloride in preventing precipitation in the presence of various levels of calcium, at various temperatures, and at a constant pH of 10.

[0018] FIG. **5** is a comparative plot illustrating the performance of STPP as a builder in the presence of various levels of calcium, at various temperatures, and at a constant pH of 12.

[0019] FIG. **6** is a plot of the performance of magnesium chloride in preventing precipitation in the presence of various levels of calcium, at various temperatures, and at a constant pH of 12.

[0020] FIG. **7** is a photograph of the interior of a dishwashing machine showing considerable lime scale deposition after it was run for 100 cycles using 17 grain hard water only.

[0021] FIG. **8** is a photograph of the interior of a dishwashing machines after it was run for 100 cycles using 17 grain hard water and with water soluble magnesium compound, magnesium sulfate, introduced as the sole rinse agent. The presence of magnesium sulfate as the sole rinse agent prevented the build-up of lime scale on metal. No builder or sheeting agent was needed to obtain this benefit.

[0022] FIG. **9** is a photograph of six glasses. Glass "C" is a control using hard water alone as the rinse agent. The other glasses were rinsed using molar ratios of magnesium to calcium of 1:1, 1.5:1, 2:1, 2.5:1, or 3:1 and are labeled as such. These ratios are based on the total amount of magnesium present including that present in the incoming water. The results in FIG. **9** show that water soluble magnesium compound, magnesium sulfate, as the sole rinse agent reduced and prevented build-up of lime scale on glasses. Surprisingly, in this example, the 1:1 molar ratio of magnesium to calcium gave increased hard water scaling on glass, while the higher ratios gave reduced scaling compared to the control glass.

[0023] FIG. **10** is a photograph of two glasses, one subjected to 100 cycles in a dishwashing machine with magnesium chloride and the other with magnesium sulfate. The molar ratio of magnesium to calcium was 1:1. Unexpectedly,

the 1:1 molar ratio of magnesium to calcium showed better results than the control when magnesium chloride was substituted for magnesium sulfate

DETAILED DESCRIPTION OF THE INVENTION

Definitions

[0024] As used herein, the term "water soluble" refers to a compound that can be dissolved in water at a concentration of more than 1 wt-%.

[0025] As used herein, the terms "sparingly soluble" or "sparingly water soluble" refer to a compound that can be dissolved in water only to a concentration of 0.1 to 1.0 wt-%.

[0026] As used herein, the term "water insoluble" refers to a compound that can be dissolved in water only to a concentration of less than 0.1 wt-%.

[0027] As used herein, the terms "chelating agent" and "sequestrant" refer to a compound that forms a complex (soluble or not) with water hardness ions (from the wash water, soil and substrates being washed) in a specific molar ratio. Chelating agents that can form a water soluble complex include sodium tripolyphosphate, EDTA, DTPA, NTA, citrate, and the like.

[0028] Sequestrants that can form an insoluble complex include sodium triphosphate, zeolite A, and the like. As used herein, the terms "chelating agent" and "sequestrant" are synonymous.

[0029] As used herein, the term "free of chelating agent" refers to a composition, mixture, or ingredients that do not contain a chelating agent or sequestrant or to which a chelating agent or sequestrant has not been added. Should a chelating agent or sequestrant be present through contamination of a composition, mixture, or ingredient that is free of chelating agent, the amount of a chelating agent or sequestrant shall be less than 7 wt-%. In another embodiment, such an amount of a chelating agent or sequestrant is less then 2 wt-%. In other embodiments, such an amount of a chelating agent or sequestrant is less then 0.5 wt-% and in yet other embodiments, such an amount of a chelating agent or sequestrant is less than 0.1 wt-%.

[0030] As used herein, the term "lacking an effective amount of chelating agent" refers to a composition, mixture, or ingredients that contains too little chelating agent or sequestrant to measurably affect the hardness of water. Accordingly, an ineffective amount of chelating agent or sequestrant will vary with the hardness of the water and the dilution rate of a concentrate.

[0031] As used herein, the term "threshold agent" refers to a compound that inhibits crystallization of water hardness ions from solution, but that need not form a specific complex with the water hardness ion. This distinguishes a threshold agent from a chelating agent or sequestrant. Threshold agents include a polyacrylate, a polymethacrylate, an olefin/maleic copolymer, and the like.

[0032] As used herein, the term "antiredeposition agent" refers to a compound that helps keep suspended in water instead of redepositing onto the object being cleaned.

[0033] As used herein, the term "phosphate-free" refers to a composition, mixture, or ingredient that does not contain a phosphate or phosphate-containing compound or to which a phosphate or phosphate-containing compound has not been added. Should a phosphate or phosphate-containing compound be present through contamination of a phosphate-free composition, mixture, or ingredients, the amount of phosphate shall be less than 0.5 wt %. More preferably, the amount of phosphate is less then 0.1 wt-%, and most preferably, the amount of phosphate is less than 0.01 wt %.

[0034] As used herein, the term "phosphorus-free" refers to a composition, mixture, or ingredient that does not contain phosphorus or a phosphorus-containing compound or to which phosphorus or a phosphorus-containing compound has not been added. Should phosphorus or a phosphorus-containing compound be present through contamination of a phosphorus-free composition, mixture, or ingredients, the amount of phosphorus shall be less than 0.5 wt %. More preferably, the amount of phosphorus is less than 0.1 wt-%, and most preferably the amount of phosphorus is less than 0.01 wt %.

[0035] "Cleaning" means to perform or aid in soil removal, bleaching, microbial population reduction, rinsing, or combination thereof.

[0036] As used herein, the term "ware" includes items such as eating and cooking utensils. As used herein, the term "warewashing" refers to washing, cleaning, or rinsing ware.

[0037] As used herein, the term "hard surface" includes showers, sinks, toilets, bathtubs, countertops, windows, mirrors, transportation vehicles, floors, and the like. These surfaces can be those typified as "hard surfaces" (such as walls, floors, bed-pans, etc.,), or fabric surfaces, e.g., knit, woven, and non-woven surfaces (such as surgical garments, draperies, bed linens, bandages, etc.,), or patient-care equipment (such as respirators, diagnostic equipment, shunts, body scopes, wheel chairs, beds, etc.,), or surgical and diagnostic equipment.

[0038] As used herein, the phrase "health care surface" refers to a surface of an instrument, a device, a cart, a cage, furniture, a structure, a building, or the like that is employed as part of a health care activity. Examples of health care surfaces include surfaces of medical or dental instruments, of medical or dental devices, of electronic apparatus employed for monitoring patient health, and of floors, walls, or fixtures of structures in which health care occurs. Health care surfaces are found in hospital, surgical, infirmity, birthing, mortuary, and clinical diagnosis rooms. Health care surfaces include articles and surfaces employed in animal health care.

[0039] As used herein, the term "instrument" refers to the various medical or dental instruments or devices that can benefit from cleaning with a stabilized composition according to the present invention.

[0040] As used herein, the phrases "medical instrument", "dental instrument", "medical device", "dental device", "medical equipment", or "dental equipment" refer to instruments, devices, tools, appliances, apparatus, and equipment used in medicine or dentistry. Such instruments, devices, and equipment can be cold sterilized, soaked or washed and then heat sterilized, or otherwise benefit from cleaning in a composition of the present invention. These various instruments, devices and equipment include, but are not limited to: diagnostic instruments, trays, pans, holders, racks, forceps, scissors, shears, saws (e.g. bone saws and their blades), hemostats, knives, chisels, rongeurs, files, nippers, drills, drill bits, rasps, burrs, spreaders, breakers, elevators, clamps, needle holders, carriers, clips, hooks, gouges, curettes, retractors, straightener, punches, extractors, scoops, keratomes, spatulas, expressors, trocars, dilators, cages, glassware, tubing, catheters, cannulas, plugs, stents, scopes (e.g., endoscopes, stethoscopes, and arthoscopes) and related equipment, and the like, or combinations thereof.

[0041] As used herein, a solid cleaning composition refers to a cleaning composition in the form of a solid such as a powder, a particle, an agglomerate, a flake, a granule, a pellet, a tablet, a lozenge, a puck, a briquette, a brick, a solid block, a unit dose, or another solid form known to those of skill in the art. The term "solid" refers to the state of the detergent composition under the expected conditions of storage and use of the solid detergent composition. In general, it is expected that the detergent composition will remain in solid form when exposed to temperatures of up to about 100° F. and greater than about 120° F.

[0042] By the term "solid" as used to describe the processed composition, it is meant that the hardened composition will not flow perceptibly and will substantially retain its shape under moderate stress or pressure or mere gravity, as for example, the shape of a mold when removed from the mold, the shape of an article as formed upon extrusion from an extruder, and the like. The degree of hardness of the solid cast composition can range from that of a fused solid block, which is relatively dense and hard, for example, like concrete, to a consistency characterized as being malleable and sponge-like, similar to caulking material.

[0043] As used herein, weight percent (wt-%), percent by weight, % by weight, and the like are synonyms that refer to the concentration of a substance as the weight of that substance divided by the total weight of the composition and multiplied by 100.

[0044] As used herein, the term "about" modifying the quantity of an ingredient in the compositions of the invention or employed in the methods of the invention refers to variation in the numerical quantity that can occur, for example, through typical measuring and liquid handling procedures used for making concentrates or use solutions in the real world; through inadvertent error in these procedures; through differences in the manufacture, source, or purity of the ingredients employed to make the compositions or carry out the methods; and the like. The term about also encompasses amounts that differ due to different equilibrium conditions for a composition resulting from a particular initial mixture. Whether or not modified by the term "about", the claims include equivalents to the quantities.

[0045] It should be noted that, as used in this specification and the appended claims, the singular forms "a," "an," and "the" include plural referents unless the content clearly dictates otherwise. Thus, for example, reference to a composition containing "a compound" includes a mixture of two or more compounds. It should also be noted that the term "or" is generally employed in its sense including "and/or" unless the content clearly dictates otherwise.

Methods and Compositions Employing Water Soluble Magnesium Compound

[0046] The present invention is useful in preparing and in use as a presoak or prewash, a cleaning agent, or a rinse agent for treating a variety of surfaces. Compositions prepared according to the invention are useful in automatic warewashing machines, in hand dishwashing, in cleaning hard surfaces such as windows, mirrors, ceramic tile and basins, granite, plastic, stainless steel, wood, countertops, or vehicles to name a few. Compositions prepared according to the invention are also useful in cleaning or treating medical or dental equipment or instruments and in washing linens. The present invention relates to compositions and methods employing a water soluble magnesium compound. The present inventors have discovered, unexpectedly, that a water soluble magnesium compound can be employed to, for example, reduce lime scale or precipitate formation from hard water, reduce formation of soap scum, remove soap scum, or the like. In certain embodiments, the composition includes and the method employs water and water soluble magnesium compound but lacks other materials commonly used in cleaning compositions. These compositions can be employed in any of a variety of situations in which water spotting or scaling are a problem, such as cleaning or rinsing a hard surface, such as tile, glass ware, other ware, and the like.

[0047] The present inventors discovered that compositions of water soluble magnesium salt that provide magnesium ion at predefined ratios to calcium ion in water, such as magnesium ion in a molar amount equal to or in excess over a molar amount of calcium ion, advantageously reduce lime scale or precipitate formation from hard water, remove soap scum, or the like. For example, magnesium ion and calcium ion can be in a molar ratio of 1:1 or the composition can include a greater amount of magnesium ion. In a more preferred embodiment, magnesium ion and calcium ion can be in a molar ratio of about 1.5:1 up to about 3:1. Further, the present inventors discovered that a compositions of water soluble magnesium salt including an anion of a water soluble calcium salt are more effective than a magnesium salt with an anion of a water insoluble calcium salt. These compositions can be used for reducing lime scale or precipitate formation from hard water, removing soap scum, or the like.

[0048] Surprisingly, water containing a water soluble magnesium salt can have beneficial effects in reducing certain deleterious effects of hard water. In fact, a composition of only water soluble magnesium salt in hard water can have these beneficial effects. It was unexpectedly discovered that a water soluble magnesium salt worked as well as a conventional chelating agent or sequestrant (sodium tripolyphosphate (STPP)) at preventing precipitation of calcium salts. Also unexpectedly, a composition of only water soluble magnesium salt in hard water reduced formation of lime scale from hard water. Further, unexpectedly, rinse water containing only a water soluble magnesium salt reduced formation of lime scale from hard water on glasses after warewashing, and on the portions of the dishwasher that contact water. Surprisingly, a composition comprising only water soluble magnesium salt in hard water removed soap scum from a tile. These benefits can be achieved employing a composition including magnesium ion in a molar amount equal to or in excess over a molar amount of calcium ion. These benefits can be achieved at a lower concentration of water soluble magnesium salt using a water soluble magnesium salt including an anion of a water soluble calcium salt are more effective than a magnesium salt with an anion of a water insoluble calcium salt.

[0049] As described above, these beneficial effects can be achieved by a composition including water and water soluble magnesium compound, but lacking other materials commonly used in cleaning compositions. That is, in certain embodiments, a composition of only water and water soluble magnesium compound can exhibit such beneficial effects. The composition can include magnesium ion in a molar amount equal to or in excess over a molar amount of calcium ion. The composition can include water soluble magnesium salt using a water soluble magnesium salt including an anion of a water soluble calcium salt.

[0050] In certain embodiments, the present composition consists essentially of water and water soluble magnesium compound. As used herein, the phrases "consisting essentially of" or "consists essentially of" refer to a composition including the listed ingredients (e.g., water and water soluble magnesium compound) but lacking an effective amount of any cleaning component commonly used in cleaning compositions.

[0051] In an embodiment, the present composition is free of cleaning components commonly used in cleaning compositions. As used herein, the phrase "free of cleaning components commonly used in cleaning compositions" refers to a composition, mixture, or ingredient that does not contain a cleaning component commonly used in cleaning compositions or to which a cleaning components commonly used in cleaning compositions has not been added. Should a cleaning component commonly used in cleaning compositions be present through contamination of a composition free of cleaning components commonly used in cleaning, the amount of cleaning component commonly used in cleaning compositions shall be less than 0.5 wt %. More preferably, the amount of cleaning component commonly used in cleaning compositions is less then 0.1 wt-%, and most preferably, the amount of cleaning component commonly used in cleaning compositions is less than 0.01 wt %.

[0052] As used herein, "cleaning component commonly used in cleaning compositions" refers to: source of alkalinity, organic surfactant or cleaning agent (e.g., surfactant or surfactant system, e.g., anionic, nonionic, cationic, and zwitterionic surfactant), pH modifier (e.g., organic or inorganic source of alkalinity or a pH buffering agent), builder (e.g., inorganic builder such as silicate, carbonate, sulfate, salt or acid form thereof), processing aid, active oxygen compound, glass or metal corrosion inhibitor, activator, rinse aid functional material, bleaching agent, defoaming agent, anti-redeposition agent, stabilizing agent, enzyme, chelating agent or sequestrant (e.g., phosphonate, phosphate, aminocarboxylate, polycarboxylate, and the like), detersive polymer, softener, source of acidity, solubility modifier, bleaching agent or additional bleaching agent, effervescent agent, or activator for the source of alkalinity.

[0053] As used herein, "cleaning component commonly used in cleaning compositions" does not include antimicrobial agent, secondary hardening agent, detergent filler, aesthetic enhancing agent (i.e., dye, odorant, perfume), lubricant composition, dispersant, or thickener.

[0054] In certain embodiments, the composition can also include antimicrobial agent, viscosity modifier (cellulosic polymers, guar derivatives and gums, etc.), aesthetic enhancing agent (i.e., dye, odorant, perfume, fragrance), lubricant composition, dispersant, preservative, or thickener.

[0055] As used herein with respect to ingredients of the present compositions, water refers to potable water as obtained from a municipal or private water system, e.g., a public water supply or a well. The water can be hard water, city water, well water, water supplied by a municipal water system, water supplied by a private water system, treated water, or water directly from the system or well. In an embodiment, the present method employs water that wasn't treated with a polymeric water softener bed such as in use today and which requires periodic regeneration with sodium chloride to work. In general, hard water refers to water having a level of calcium and magnesium ions in excess of about 100 ppm. Often, the molar ratio of calcium to magnesium in hard water is about 2:1 or about 3:1. Although most locations have hard water, water hardness tends to vary from one location to another.

COMPOSITIONS OF THE INVENTION

[0056] In an embodiment, the present invention includes an aqueous composition consisting essentially of water and a water soluble magnesium salt. In an alternate embodiment, the aqueous composition further consists essentially of thickener. In another embodiment, the aqueous composition consists of water and a water soluble magnesium salt. In yet another embodiment, the aqueous composition consists essentially of water, water soluble magnesium salt, and a further ingredient selected from the group consisting of antimicrobial agent, viscosity modifier, aesthetic enhancing agent, lubricant, dispersant, preservative, thickener, or mixture thereof.

[0057] This composition can include, upon dilution for use, magnesium ion in a molar amount equal to or in excess over a molar amount of calcium ion. Upon dilution for use, the composition includes magnesium ion at a wt-% greater than or equal to one half times a wt-% of calcium ion. The water soluble magnesium salt preferably includes an anion that forms an insoluble calcium salt; and the aqueous composition, upon dilution for use, includes magnesium ion in a molar amount equal to or greater than two-times the molar amount of calcium ion. An aqueous composition of the invention preferably includes less than 1 wt-% phosphorus and/or less than 1 wt-% phosphate.

[0058] The present invention includes a composition including a water soluble magnesium salt and a further ingredient selected from the group consisting of antimicrobial agent, viscosity modifier, aesthetic enhancing agent, lubricant, dispersant, preservative, thickener, or mixture thereof. In an alternate embodiment, the composition consists essentially of a water soluble magnesium salt and a further ingredient selected from the group consisting of antimicrobial agent, viscosity modifier, aesthetic enhancing agent, lubricant, dispersant, preservative, thickener, or mixture thereof.

[0059] In an embodiment, the composition is a solid block. The solid block can include about 99 to 100 wt-% water soluble magnesium salt. In such an embodiment, the composition preferably comprises less than 1 wt-% phosphorus and/or less than 1 wt-% phosphate.

[0060] The composition can include magnesium compound at a predetermined ratio to the calcium in water. The magnesium compound can be a water soluble magnesium salt including an anion that forms a water soluble salt with calcium. Anions that form water soluble salts with both magnesium ion and calcium ion include chloride and acetate. Sulfate form a water soluble salt with magnesium, but its calcium salt is water insoluble. The composition can lack an effective amount or be substantially free of, for example, chelating agent, sequestrant, builder, threshold agent, surfactant, and sheeting agent.

METHODS OF THE INVENTION

[0061] It is contemplated that the cleaning compositions of the invention can be used in a broad variety of industrial, household, health care, vehicle care, and other such applications. Some examples include surface antimicrobial, ware cleaning, vehicle cleaning, floor cleaning, surface cleaning,

pre-soaks, clean in place, window cleaning, and a broad variety of other such applications.

[0062] The present invention includes a method of cleaning an object. This method of cleaning preferably results in reducing hard water spotting, scaling, or deposits. This embodiment of the method can include contacting the object with an aqueous composition including water and a water soluble magnesium salt. The method can also include recovering the object with an acceptable amount of hard water spotting, scaling, or deposits.

[0063] The following rating system is used to grade spotting on hard surfaces. In developing the rating system, clear glasses were used. Surfaces having a rating of 1, 1.5 and 2 are considered to have an acceptable amount of spotting. Surfaces having a rating of 3 have a marginally acceptable amount of spotting while surfaces rated a 4 or a 5 have unacceptable amounts of spotting.

Rating	Spots	Film
1	Substantially No spotting	No film
1.5	⅛ surface spotted	No film to barely perceptible
2	¼ surface spotted	Trace/barely perceptible
3	½ surface spotted	Slight film
4	¾ surface spotted	Moderate film
5	Entire surface spotted	Heavy film

As used herein, an acceptable amount of hard water spotting, scaling, or deposits refers to surfaces rated a 1, 1.5 or 2 in the provided grid. In other words, surfaces having as much as one quarter of the surface spotted and/or only a barely perceptible film present are deemed acceptable. In other embodiments, surfaces having less than one quarter of the surface containing spots are deemed acceptable. In yet other embodiments, surfaces have up to about ⅛ of the surface containing spotting is deemed acceptable and in other embodiments the surface is substantially free of spotting.

[0064] During contacting, the aqueous composition can include magnesium ion in a molar amount equal to or in excess over the molar amount of calcium ion. In one embodiment, the aqueous composition during contacting includes magnesium ion at a wt-% greater than or equal to one half times the wt-% of calcium ion. In another embodiment, the water soluble magnesium salt comprises an anion that forms an insoluble or sparingly soluble calcium salt and the aqueous composition during contacting includes magnesium ion in a molar amount equal to or greater than two-times the molar amount of calcium ion.

[0065] One skilled in the art will appreciate that the higher the solubility of the calcium salt formed from the anion from the soluble magnesium compound, the lower the ratio of magnesium to calcium need be. In other words, if the calcium salt that forms is highly soluble, the ratio of magnesium to calcium concentration will approach 1:1 whereas, if the resultant calcium salt is low in solubility, the ratio of magnesium to calcium will need to be higher than 1:1.

[0066] In one embodiment of the present invention the aqueous composition consists essentially of water and a water soluble magnesium salt. In another embodiment, the aqueous composition consists of water and a water soluble magnesium salt. In yet another embodiment, the aqueous composition consists essentially of water, water soluble magnesium salt, and a further ingredient selected from the group consisting of antimicrobial agent, viscosity modifier, aesthetic enhancing agent, lubricant, dispersant, preservative, thickener, or mixture thereof.

[0067] The method can be applied to cleaning any of a variety of objects. For example, contacting can include contacting any of a variety of objects or surfaces. In one version of the method of the invention, contacting includes rinsing a hard surface. The hard surface is selected from the group consisting of ceramic tile, a window, and a combination thereof. The hard surface may exist in a bathroom or in a kitchen. In another embodiment, contacting includes rinsing or presoaking ware. The invention may also be used to rinse or wash a medical instrument or rinse or wash a vehicle in a car wash.

[0068] The method can reduce any of a variety of detrimental effects of hard water. In an embodiment, the method can reduce scaling. The invention is remarkably effective in removing existing soap scum from a hard surface. In such a method the soap scum on an object is contacted with an aqueous composition including water and a water soluble magnesium salt and the soap scum is removed from the object. In another embodiment, the aqueous composition consists essentially of water and a water soluble magnesium salt. The aqueous composition may further consist essentially of thickener. In an embodiment, the aqueous composition consists of water and a water soluble magnesium salt. The aqueous composition may consist essentially of water, water soluble magnesium salt, and a further ingredient selected from the group consisting of antimicrobial agent, viscosity modifier, aesthetic enhancing agent, lubricant, dispersant, preservative, thickener, or mixture thereof.

[0069] The method can remove soap scum from any of a variety of surfaces. In an embodiment, contacting includes contacting a bathroom surface. Contacting may also include ceramic tile, an interior surface of a warewashing machine and, removing the soap scum resulting in a shiny surface. This method can be employed to remove any of a variety of types of soap scum. For example, the soap scum can include calcium salt of fatty acid, alone or in the presence of other soils such as triglycerides and/or protein, which can make the soap scum more adherent to surfaces.

[0070] This method can be employed to remove soap scum from any of a variety of types of surfaces. The soap scum can be on a bathroom surface. The bathroom surface can be a surface in or around a shower, such as a shower stall, a plumbing fixture, a wall, a glass shower door, or the like. The soap scum can be on a surface of a warewashing machine. In an embodiment, the soap scum is on a hard surface. The hard surface can be a vehicle, eating or cooking utensil, architectural surface such as a window or floor, or a countertop.

[0071] In this method, effectively removing the soap scum can refer to removing a visually detectable amount of the soap scum from the surface. In one aspect, effectively removing the soap scum results in a shiny surface. Effectively removing the soap scum results in a surface free of lime scale without having to use a water softening polymer bed. In one embodiment of the invention, the aqueous composition containing excess calcium ion contains at least about 50 ppm calcium ion, e.g. at least about 5 grain per gallon of hardness due to calcium ion. In an embodiment of this method, adding includes adding the water soluble magnesium compound to achieve a total wt-% of magnesium ion of about half the wt-% of calcium ion. For example, at least about 2 grains of total magnesium ion for water containing 5 grains of calcium ion

as water hardness. In an embodiment of this method, adding includes adding water soluble magnesium compound including an anion that forms a soluble salt with calcium (e.g., $MgCl_2$) to achieve a total wt-% of magnesium ion of greater than about half the wt-% of calcium ion (which is about a 1:1 molar ratio). In an embodiment of this method, adding includes adding water soluble magnesium compound including an anion that forms an insoluble salt with calcium (e.g., $MgSO_4$) to achieve a total wt-% of magnesium ion of about the wt-% of calcium ion (which is about a 2:1 molar ratio).

[0072] The present invention includes a composition or method employing water soluble magnesium compound plus water for lime scale control. In one embodiment, the present invention includes a method of reducing calcium precipitate or lime scale from an aqueous composition. This method can include: providing aqueous composition containing excess calcium ion; adding a water soluble magnesium compound to the aqueous composition containing excess calcium ion; employing aqueous composition to which magnesium compound was added for cleaning. The magnesium treated water can be used for any of a variety of purposes in which it is desirable to reduce calcium precipitate or lime scale from an aqueous composition. For example, this method can include employing aqueous composition to which magnesium compound was added for rinsing ware in warewashing. The method can include providing magnesium ion at predefined ratios to calcium ion in water, such as magnesium ion in a molar amount equal to or in excess over a molar amount of calcium ion. Such methods can advantageously reduce lime scale or precipitate formation from hard water, remove soap scum, or the like. The method can employ a water soluble magnesium salt including an anion of a water soluble calcium salt are more effective than a magnesium salt with an anion of a water insoluble calcium salt.

[0073] The present invention also includes a method of reducing precipitation of calcium salt from an aqueous composition. This method can include: providing aqueous composition containing excess calcium ion; adding a water soluble magnesium compound to the aqueous composition containing excess calcium ion; and employing the aqueous composition to which magnesium compound was added for rinsing ware in warewashing, as a presoak for ware in warewashing, as a detergent for ware in warewashing, for rinsing a vehicle in a car wash, for rinsing a shower or other bathroom fixture, for rinsing a window, or the like. The composition can be free of builder, sequestrant, chelating agent, or threshold agent. The method can include providing magnesium ion at predefined ratios to calcium ion in water, such as magnesium ion in a molar amount equal to or in excess over a molar amount of calcium ion. Such methods can advantageously reduce lime scale or precipitate formation from hard water, remove soap scum, or the like. The method can employ a water soluble magnesium salt including an anion of a water soluble calcium salt are more effective than a magnesium salt with an anion of a water insoluble calcium salt.

[0074] The present invention includes a method of cleaning an object. This method can include: providing a solid block of a water soluble magnesium compound; contacting the solid block with an aqueous composition to form an aqueous composition including water soluble magnesium compound; and applying the aqueous composition comprising water soluble magnesium compound to an object to clean the object. The method can include providing magnesium ion at predefined ratios to calcium ion in water, such as magnesium ion in a molar amount equal to or in excess over a molar amount of calcium ion. Such methods can advantageously reduce lime scale or precipitate formation from hard water, reduce hard water spotting, remove soap scum, or the like. The method can employ a water soluble magnesium salt including an anion of a water soluble calcium salt are more effective than a magnesium salt with an anion of a water insoluble calcium salt.

[0075] In one embodiment, the present invention includes a solid block cleaning composition. The solid block cleaning composition can include about 99 to 100 wt-% water soluble magnesium compound.

[0076] In another embodiment, the present methods can include injecting the present aqueous composition or placing the present solid composition into the water flow being used to rinse the surface. In an embodiment, the present method employs water that wasn't treated with a polymeric water softener bed such as in use today requiring periodic regeneration with sodium chloride for effectiveness.

[0077] Contacting can include any of numerous methods for applying a composition, such as spraying the composition, immersing the object in the composition, or a combination thereof. The compositions can be applied in a variety of areas including kitchens, bathrooms, factories, hospitals, dental offices and food plants, and can be applied to a variety of hard surfaces having smooth, irregular or porous topography. Suitable hard surfaces include, for example, architectural surfaces (e.g., floors, walls, windows, sinks, tables, counters and signs); eating utensils; hard-surface medical or surgical instruments and devices; and hard-surface packaging. Such hard surfaces can be made from a variety of materials including, for example, ceramic, metal, glass, wood or hard plastic.

[0078] A concentrate or use concentration of a composition of the present invention can be applied to or brought into contact with an object by any conventional method or apparatus for applying a cleaning composition to an object. For example, the object can be wiped with, sprayed with, and/or immersed in the composition, or a use solution made from the composition. The composition can be sprayed, or wiped onto a surface; the composition can be caused to flow over the surface, or the surface can be dipped into the composition. Contacting can be manual or by machine.

Water Soluble Magnesium Compounds

[0079] Suitable water soluble magnesium compounds include those selected from the group consisting of magnesium acetate, magnesium benzoate, magnesium bromide, magnesium bromate, magnesium chlorate, magnesium chloride, magnesium chromate, magnesium citrate, magnesium formate, magnesium hexafluorosilicate, magnesium iodate, magnesium iodide, magnesium lactate, magnesium molybdate, magnesium nitrate, magnesium perchlorate, magnesium phosphinate, magnesium salicylate, magnesium sulfate, magnesium sulfite, magnesium tartrate, magnesium thiosulfate, a hydrate thereof, and a mixture thereof. These salts can be provided as hydrated salts or anhydrous salts.

[0080] Suitable water soluble magnesium compounds include magnesium salts with an anion that also forms a soluble salt with calcium. Such salts include those selected from the group consisting of magnesium acetate, magnesium benzoate, magnesium bromide, magnesium bromate, magnesium chlorate, magnesium chloride, magnesium chromate, magnesium formate, magnesium iodide, magnesium lactate,

magnesium nitrate, magnesium perchlorate, magnesium phosphinate, magnesium salicylate, a hydrate thereof, and a mixture thereof. These salts can be provided as hydrated salts or anhydrous salts.

[0081] Water soluble magnesium compounds approved as GRAS for direct food contact include magnesium chloride and magnesium sulfate.

[0082] A cast or pressed solid block or puck of water soluble magnesium compound can also contain water insoluble magnesium compound. The water insoluble compound can slow the speed at which the water soluble magnesium compound dissolves to provide a useful solid cleaning composition. In certain embodiments, the ratio of water soluble to water insoluble magnesium compound can be about 1:10 to about 10:1, about 1:5 to about 5:1, or about 1:3 to about 3:1.

Additional Ingredients

[0083] In certain embodiments, the composition can also include antimicrobial agent, viscosity modifier (cellulosic polymers, guar derivatives and gums, etc.), aesthetic enhancing agent (i.e., dye, odorant, perfume, fragrance), lubricant composition, dispersant, preservative, or thickener. Such ingredients are known and are described in, for example, U.S. Patent Application Publication No. 2003/0139310 and/or No. 20060113506, which are incorporated herein by reference for all purposes.

Ingredients to Exclude

[0084] The composition can lack an effective amount or be substantially free of, for example, additional functional components or ingredients such as chelating agent, sequestrant, builder, threshold agent, surfactant, and sheeting agent.

[0085] The present composition can be substantially free of added sequestrant or chelating agent or, even, free of added sequestrant or chelating agent. In an embodiment, the present cleaning composition is substantially free or free of added sequestrant or chelating agent. Chelating agents or sequestrants include phosphonates, phosphates, aminocarboxylates, polycarboxylates, and the like.

[0086] In a preferred embodiment, the present composition does not include and the present method does not employ a surfactant or surfactant system. Excluded surfactants include anionic, nonionic, cationic, and zwitterionic surfactants, which are commercially available from a number of sources.

[0087] In another embodiment, the present composition does not include and the present method does not employ a wetting or sheeting agent. A wetting or sheeting agent is typically a water soluble or dispersible low foaming organic material capable of reducing the surface tension of the rinse water to promote sheeting action and to prevent spotting or streaking caused by beaded water after rinsing is completed.

Use Compositions

[0088] The present compositions include concentrate compositions and use compositions. For example, a concentrate composition can be diluted, for example with water, to form a use composition. In an embodiment, a concentrate composition can be diluted to a use solution before application to an object. For reasons of economics, the concentrate can be marketed and an end user can dilute the concentrate with water or an aqueous diluent to a use solution. The level of active components in the concentrate composition is dependent on the intended dilution factor and the desired concentration of water soluble magnesium salt.

[0089] Generally, a dilution of about 1 fluid ounce to about 20 gallons of water to about 5 fluid ounces to about 1 gallon of water is used for aqueous cleaning compositions. In the typical use locus, the concentrate is diluted with a major proportion of water using commonly available tap or service water mixing the materials at a dilution ratio of about 3 to about 20 ounces of concentrate per 100 gallons of water. A use solution may be prepared from the concentrate by diluting the concentrate with water at a dilution ratio that provides a use solution having desired properties. In an exemplary embodiment, the concentrate may be diluted at a weight ratio of diluent to concentrate of at least about 20:1 or about 20:1 to about 2000:1.

[0090] The concentrate may be diluted with water at the location of use to provide the use solution. When the detergent composition is used in an automatic warewashing or dishwashing machine, it is expected that that the location of use will be inside the automatic warewashing machine.

EMBODIMENTS OF SOLIDS

[0091] The present invention also relates to solid cleaning compositions including a water soluble magnesium compound. For example, the present invention includes a cast solid block of magnesium chloride. By way of further example, the present invention includes a pressed solid block or puck including water soluble magnesium compound and magnesium carbonate.

[0092] According to the present invention, a solid cleaning composition of a water soluble magnesium compound (e.g. magnesium chloride) can be prepared by a method including: providing a powder or crystalline form of a water soluble magnesium compound (e.g. magnesium chloride); melting the powder or crystalline form of the water soluble magnesium compound; transferring the molten water soluble magnesium compound into a mold; and cooling the molten salt to solidify it. For example, a solid block of magnesium chloride was made by heating magnesium chloride hexahydrate to its melting point of about 118° C. The molten salt was then transferred to a plastic container to afford a hard solid upon cooling to ambient temperature. For forming a cast solid from magnesium chloride, the presence of water of hydration (and additional water if desired) affords a reduced melting point compared to the anhydrous salt, allowing the temperature of the process to be reduced to a practical level.

[0093] According to the present invention, a solid cleaning composition of a water soluble magnesium compound (e.g. magnesium carbonate) can be prepared by a method including: providing a powder or crystalline form of a water soluble magnesium compound (e.g. magnesium carbonate); gently pressing the water soluble magnesium compound to form a solid (e.g., block or puck). A solid block was made by compressing about 50 grams of magnesium carbonate monohydrate for about 20 seconds at about 1000 psi.

[0094] A solid (e.g., block or puck, pressed or cast) form of a water soluble magnesium compound can be used, for example, for treating of potable water, for treating a facility or home's overall water system, or for treating water fed into a mechanical device such as a dishwasher, or car wash. The method can include, for example, contacting the solid form of a water soluble magnesium compound with water in need of treatment; and using the water for cleaning. The magnesium

ions can reduce undesirable precipitation of calcium salts. The magnesium can thus continuously treat water as the solid composition dissolves.

[0095] A solid cleaning or rinsing composition as used in the present disclosure encompasses a variety of forms including, for example, solids, pellets, blocks, and tablets, but not powders. 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 cleaning composition. In general, it is expected that the detergent composition will remain a solid when provided at a temperature of up to about 100° F. or greater than 120° F.

[0096] In certain embodiments, the solid cleaning composition is provided in the form of a unit dose. A unit dose refers to a solid cleaning composition unit sized so that the entire unit is used during a single washing cycle. When the solid cleaning composition is provided as a unit dose, it can have a mass of about 1 g to about 50 g. In other embodiments, the composition can be a solid, a pellet, or a tablet having a size of about 50 g to 250 g, of about 100 g or greater, or about 40 g to about 11,000 g.

[0097] In other embodiments, the solid cleaning composition is provided in the form of a multiple-use solid, such as, a block or a plurality of pellets, and can be repeatedly used to generate aqueous detergent compositions for multiple washing cycles. In certain embodiments, the solid cleaning composition is provided as a solid having a mass of about 5 g to 10 kg. In certain embodiments, a multiple-use form of the solid cleaning composition has a mass of about 1 to 10 kg. In further embodiments, a multiple-use form of the solid cleaning composition has a mass of about 5 kg to about 8 kg. In other embodiments, a multiple-use form of the solid cleaning composition has a mass of about 5 g to about 1 kg, or about 5 g and to 500 g.

Packaging System

[0098] In some embodiments, the solid composition can be packaged. The packaging receptacle or container may be rigid or flexible, and composed of any material suitable for containing the compositions produced according to the invention, as for example glass, metal, plastic film or sheet, cardboard, cardboard composites, paper, and the like.

[0099] Advantageously, since the composition is processed at or near ambient temperatures, the temperature of the processed mixture is low enough so that the mixture may be formed directly in the container or other packaging system without structurally damaging the material. As a result, a wider variety of materials may be used to manufacture the container than those used for compositions that processed and dispensed under molten conditions.

[0100] Suitable packaging used to contain the compositions is manufactured from a flexible, easy opening film material.

Dispensing of the Processed Compositions

[0101] The solid cleaning composition according to the present invention can be dispensed in any suitable method generally known. The cleaning or rinsing composition can be dispensed from a spray-type dispenser such as that disclosed in U.S. Pat. Nos. 4,826,661, 4,690,305, 4,687,121, 4,426,362 and in U.S. Pat. Nos. Re 32,763 and 32,818, the disclosures of which are incorporated by reference herein for all purposes. Briefly, a spray-type dispenser functions by impinging a water spray upon an exposed surface of the solid composition to dissolve a portion of the composition, and then immediately directing the concentrate solution including the composition out of the dispenser to a storage reservoir or directly to a point of use. When used, the product is removed from the package (e.g.) film and is inserted into the dispenser. The spray of water can be made by a nozzle in a shape that conforms to the solid shape. The dispenser enclosure can also closely fit the detergent shape in a dispensing system that prevents the introduction and dispensing of an incorrect detergent. The aqueous concentrate is generally directed to a use locus.

[0102] In an embodiment, the present composition can be dispensed by immersing either intermittently or continuously in water. The composition can then dissolve, for example, at a controlled or predetermined rate. The rate can be effective to maintain a concentration of dissolved cleaning agent that is effective for cleaning.

[0103] In an embodiment, the present composition can be dispensed by scraping solid from the solid composition and contacting the scrapings with water. The scrapings can be added to water to provide a concentration of dissolved cleaning agent that is effective for cleaning.

[0104] The present invention can be better understood with reference to the following examples. These examples are intended to be representative of specific embodiments of the invention, and are not intended as limiting the scope of the invention.

EXAMPLES

Example 1

Water Soluble Magnesium Compounds Reduce Precipitation of Calcium Salts from Hard Water

[0105] This Example demonstrates that adding a hardness ion (Mg^{2+}) to water worked as well as a conventional chelating agent or sequestrant (sodium tripolyphosphate (STPP)) at preventing precipitation of calcium salts.

Materials and Methods

[0106] Formation of a precipitate in water reduces the transmission of visible light through the water. A transmittance of 100% indicates that no precipitate formed, while a transmittance of 0% indicates that so much precipitate formed that light no longer passed through the sample. Transmittance was measured for water containing either $MgCl_2$ (present invention) or STPP (comparative example) at pH values of about 8, about 10, and about 12, and at temperatures of about 20° C., about 45° C., and about 70° C. Temperatures were chosen in an attempt to reflect room temperature (20° C.), general laundry temperature (45° C.) and general automatic warewashing temperature (70° C.). The results are reported in FIGS. **1-6** and the Tables below.

Results

[0107] The data obtained is shown in FIGS. **1-6** and the corresponding Tables below.

[0108] The graphs in FIGS. **1-6**, which each have an x, y, and z axis. The x-axis is a measure of the molar ratio of calcium to builder, e.g., STPP or water soluble magnesium compound. The y-axis is a measure of the level of light transmittance thru the samples with 0% being no light transmitted and 1100% being the entire beam of light transmitted. Full or partial loss of transmittance occurs as a consequence of the presence of particulate formation in the initially clear

samples. An effective builder prevents or reduces precipitation resulting in a clear sample. The z-axis is a measure of the test temperature, ranging from 20-60° C.

[0109] FIG. **1** is illustrative of a comparative example. FIG. **1** is a plot of the performance of STPP as a builder in the presence of various levels of calcium, at various temperatures, and at a constant pH of 8 and illustrating the impact of Ca/builder ratio and temperature on the building performance of STPP. Data for FIG. **1** is provided in the table below. Generally, the plot of FIG. **1** shows that STPP is a good chelating agent and as expected as the concentration of calcium ions increases and as the temperature increases, STPP has decreasing effectiveness in chelating calcium ions as reflected in the reduction in the transmittance of the samples.

pH	T (C.)	ppm CaCO3	% Transmittance	Ca/STPP (wt)	Ca/STPP (molar)
8	20	50	100	0.07	0.61
8	20	300	81.1	0.40	3.68
8	20	600	67.4	0.80	7.36
8	45	50	99.2	0.07	0.61
8	45	300	72.6	0.40	3.68
8	45	600	64.1	0.80	7.36
8	70	50	99.1	0.07	0.61
8	70	300	41.3	0.40	3.68
8	70	600	41.5	0.80	7.36

[0110] FIG. **2** is illustrative of the invention. FIG. **2** is a plot of the performance of magnesium chloride in preventing precipitation in the presence of various levels of calcium, at various temperatures, and at a constant pH of 8. Data for FIG. **2** is provided in the table below. This graph shows that a water soluble salt of magnesium (e.g., magnesium chloride) was unexpectedly capable of controlling the precipitation of water hardness even at a neutral pH. Generally, the plot of FIG. **2** shows that magnesium chloride is a good chelating agent and as the concentration of calcium ions increases and as the temperature increases, magnesium chloride has decreasing effectiveness in chelating calcium ions as reflected in the reduction in the transmittance of the samples. The results shown in FIG. **2** are surprisingly consistent with that shown in the comparative FIG. **1**.

pH	T (C.)	ppm CaCO3	% Transmittance	$Ca/MgCl_2$ (wt)	$Ca/MgCl_2$ (molar)
8	20	50	98.1	0.07	0.32
8	20	300	91.1	0.40	1.90
8	20	600	48	0.80	3.81
8	45	50	96.2	0.07	0.32
8	45	300	92.3	0.40	1.90
8	45	600	55.8	0.80	3.81
8	70	50	96.3	0.07	0.32
8	70	300	92.3	0.40	1.90
8	70	600	50.9	0.80	3.81

[0111] FIG. **3** is a plot illustrative of a comparative example. FIG. **3** shows the performance of STPP as a builder in the presence of various levels of calcium, at various temperatures, and at a constant pH of 10. Data for FIG. **3** is provided in the table below. A comparison of this graph with the results obtained at pH 8 (FIG. **1**) shows that the increased alkalinity gives reduced building performance at elevated temperatures, particularly around 60° C.

pH	Temp. (C.)	Ppm $CaCO_3$	% Transmittance	Ca/STTP (wt)	Ca/STPP (molar)
10	20	50	99.7	0.07	0.61
10	20	300	70.6	0.40	3.68
10	20	600	51.2	0.80	7.36
10	45	50	98.5	0.07	0.61
10	45	300	49.9	0.40	3.68
10	45	600	36.8	0.80	7.36
10	70	50	98.2	0.07	0.61
10	70	300	22.4	0.40	3.68
10	70	600	26	0.80	7.36

[0112] FIG. **4** is a plot illustrative of the invention. FIG. **4** shows the performance of magnesium chloride in preventing precipitation in the presence of various levels of calcium, at various temperatures, and at a constant pH of 10. Data for FIG. **4** is provided in the table below. This graph shows that a water soluble salt of magnesium (e.g., magnesium chloride) was unexpectedly capable of controlling the precipitation of water hardness even at a basic pH. The increased alkalinity did not significantly affect the degree of calcium precipitation compared to pH 8 (FIG. **2**). This is unexpected.

pH	T (C.)	ppm CaCO3	% Transmittance	$Ca/MgCl_2$ (wt)	$Ca/MgCl_2$ (molar)
10	20	50	97.4	0.07	0.32
10	20	300	87.8	0.40	1.90
10	20	600	37.6	0.80	3.81
10	45	50	96.5	0.07	0.32
10	45	300	81.1	0.40	1.90
10	45	600	35.4	0.80	3.81
10	70	50	86.1	0.07	0.32
10	70	300	72.4	0.40	1.90
10	70	600	38.1	0.80	3.81
10	45	300	79.9	0.40	1.90
10	45	300	82	0.40	1.90
10	45	300	81.4	0.40	1.90

[0113] FIG. **5** is a plot illustrative of a comparative example. FIG. **5** shows the performance of STPP as a builder in the presence of various levels of calcium, at various temperatures, and at a constant pH of 12. Data for FIG. **5** is provided in the table below. This graph shows that STPP has quit working to control calcium precipitation at molar ratios of 4 Ca/STPP and higher with light transmittance dropping down to about 20%. Once again elevated temperatures make the STPP system more sensitive to water hardness.

pH	Temp. (C.)	Ppm $CaCO_3$	% Transmittance	Ca/STTP (wt)	Ca/STPP (molar)
12	20	50	98.8	0.07	0.61
12	20	300	35.4	0.40	3.68
12	20	600	25.5	0.80	7.36
12	45	50	99.2	0.07	0.61
12	45	300	26.4	0.40	3.68
12	45	600	19.7	0.80	7.36
12	70	50	100	0.07	0.61
12	70	300	20.3	0.40	3.68
12	70	600	13.4	0.80	7.36

[0114] FIG. **6** is illustrative of the invention. FIG. **6** shows a plot of the performance of magnesium chloride in preventing precipitation in the presence of various levels of calcium, at various temperatures, and at a constant pH of 12. A comparison of this graph with FIG. **5** shows that under very alkaline conditions a water soluble magnesium compound such as magnesium chloride is comparable to STPP in controlling water hardness

pH	T (C.)	ppm CaCO3	% Transmittance	$Ca/MgCl_2$ (wt)	$Ca/MgCl_2$ (molar)
12	20	50	78.9	0.07	0.32
12	20	300	65.9	0.40	1.90
12	20	600	30.9	0.80	3.81
12	45	50	69	0.07	0.32
12	45	300	57.6	0.40	1.90
12	45	600	27.6	0.80	3.81
12	70	50	62.9	0.07	0.32
12	70	300	51.1	0.40	1.90
12	70	600	24.7	0.80	3.81

Discussion

[0115] As can be seen in FIGS. **1-6**, magnesium chloride matched or exceeded the ability of STPP to soften water under most conditions. By matched or exceeded the ability we mean that the magnesium chloride reduced lime scale (as reflected by percent transmittance) to a level comparable to or lower than that achieved with STPP, e.g., for most molar ratios of calcium and builder. In particular, the performance of magnesium chloride at pH values of 8 and 10 exceeded the performance of STPP at all temperature values.

[0116] At a pH value of 12, magnesium chloride started at about 80% transmittance, but had a lower slope compared to STPP. The lower slope indicates better control of water hardness precipitation as the ratio of calcium/builder increased.

Example 2

Water Soluble Magnesium Compounds Reduce Formation of Scale from Hard Water

[0117] This Example demonstrates that adding a hardness ion (Mg^{2+}) to water reduced formation of lime scale from hard water.

Materials and Methods

[0118] Tap water with 17 grain hardness and a 2:1 Ca:Mg weight ratio was spiked with various levels of magnesium chloride and then incubated in glass bottles in a 140° F. oven for about two weeks. The bottles were then visually evaluated for lime scale build-up.

Results

[0119] The results are presented in the table below.

Magnesium Chloride Added (wt-%)	Scale on Bottle
0	present
0.007	present
0.067	present
0.48	none
2.4	none
7.2	none
14	none

[0120] The data clearly shows the benefit of adding water soluble magnesium salt to the tap water. In particular, when 0.48 wt-% or more of magnesium chloride was added, no lime scale build-up was observed on the surface of the glass bottle. By contrast, when either no magnesium was present, or when less magnesium chloride was added, lime scale build-up was observed on the surface of the glass bottle.

Example 3

Injecting Water Soluble Magnesium Compounds for Rinse Cycle Reduced Formation of Scale from Hard Water in Warewashing Machine

[0121] This Example demonstrates that, injecting only a hardness ion (Mg^{2+}) into rinse water reduced formation of lime scale from hard water on a dishwasher.

Materials and Methods

[0122] A dishwashing machine was run for 100 cycles using 17 grain hard water for the wash and rinse cycles with no added rinse agent. A dishwashing machine was run for 100 cycles using 17 grain hard water and with water soluble magnesium compound, magnesium sulfate, introduced as the sole rinse agent. The magnesium sulfate was introduced at a molar ratio of magnesium ion to calcium ion of 1:1. No detergent was used in any of the wash cycles.

Results

[0123] FIGS. **7** and **8** are photographs of interiors of dishwashing machines after 100 cycles run using 17 grain hard water only or using 17 grain hard water and with water soluble magnesium compound, magnesium sulfate, introduced as the sole rinse agent.

[0124] The presence of water soluble magnesium salt, magnesium sulfate, as the sole rinse agent prevented the build-up of hard water lime scale on metal as shown in FIG. **8**. FIG. **8** shows the interior of an automatic dishwashing machine with substantially no lime scale. In fact, the interior of FIG. **8** is shiny and appears as would the interior of a new automatic dishwashing machine. FIG. **7** shows appreciable hard water lime scale on the interior of the machine. The lime scale is dull and the dishwasher appears as if a white powder was dusted on the interior surfaces. No builder or sheeting agent was needed to obtain this benefit.

Example 4

Magnesium Sulfate as a Source of Magnesium Ion in Excess Over Calcium Ion Reduced Scale Formation on Glasses

[0125] This Example demonstrates that rinsing glasses with hard water containing only added hardness ion (Mg^{2+}) reduced formation of lime scale from hard water on glasses when magnesium ion was in excess over calcium ion.

Materials and Methods

[0126] A glass was run though a dishwashing machine for 100 cycles using 17 grain hard water for the wash and rinse cycles with no added rinse agent. Other glasses were run though a dishwashing machine for 100 cycles using 17 grain hard water in a dishwashing machine with water soluble magnesium compound, magnesium sulfate, introduced as the sole rinse agent. In separate series of 100 cycles, the magnesium sulfate was introduced at varying concentrations to provide molar ratios of magnesium ion to calcium ion of 1:1, 1.5:1, 2:1, 2.5:1, and 3:1. No detergent was used in any of the wash cycles.

Results

[0127] The results in FIG. **9** show that water soluble magnesium compound, magnesium sulfate, as the sole rinse agent reduced and prevented build-up of hard water scale on glassware. In FIG. **9**, glass "C" is a control using hard water alone as the rinse agent. The other glasses were rinsed using various molar ratios of magnesium to calcium ranging from 1-3 moles magnesium ion to calcium ion.

[0128] These ratios are based on the total amount of magnesium present including that present in the incoming water. Glass "C" in FIG. **9** is clouded in appearance. It looks as though it is frosted or has been etched with an etchant. Glass 1:1 is even cloudier or more frosted than the control glass. Glasses 1.5:1 up to glass 3:1 are increasingly clearer in appearance than the previous glass (lower ratio) until the 3:1 glass has substantially no filming, spotting, cloudiness, or etched appearance. Unlike the deposits on the metal of the dishwasher, rinsing glasses with a 1:1 ratio of magnesium to calcium increased precipitation of hard water scale relative to the control. However, a 1.5:1 ratio and higher gave significant improvement up to a glass free of lime scale at a ratio of 3:1.

Example 5

Soluble Magnesium Salt Including Anion of Soluble Calcium Salt Reduced Formation of Scale from Hard Water in Warewashing at Lower Ratios

[0129] This Example shows a water soluble magnesium salt ($MgCl_2$) providing an anion that forms a water soluble calcium salt reduced formation of lime scale from hard water at lower ratios of Mg^{2+} to Ca^{2+} than a magnesium salt ($MgSO_4$) providing an anion of a water insoluble calcium salt.

Materials and Methods

[0130] A first glass and a second glass were run though a dishwashing machine for 100 cycles using 17 grain hard water in a dishwashing machine with water soluble magnesium compound, magnesium chloride or magnesium sulfate, introduced as the sole rinse agent. The water soluble magnesium compounds were introduced at molar ratios of magnesium ion to calcium ion of 1:1. No detergent was used in any of the wash cycles.

Results

[0131] The results in FIG. **10** compare glasses rinsed with two sources of water soluble magnesium compound as the source of the added magnesium ion. Magnesium chloride and calcium chloride are both soluble. However, magnesium sulfate is soluble but calcium sulfate is only slightly soluble.

Compound	Water Solubility (20° C.)
magnesium chloride	54.6
magnesium sulfate	33.7
calcium chloride	42.0
calcium sulfate	0.2

Interestingly, magnesium chloride effectively reduced formation of lime scale from hard water at a lower concentration than magnesium sulfate.

[0132] A magnesium compound such as magnesium chloride where the analogous calcium salt is water soluble was found to be more effective in preventing hard water scale than one where the analogous calcium salt is water insoluble. FIG. **10** illustrates this at a 1:1 molar ratio of total magnesium ion to calcium ion for both salts. The glass on the left, treated with a 1:1 molar ratio of $MgCl_26H_2O$ is substantially clear whereas the glass on the right, treated with a 1:1 molar ratio of $MgSO_47H_2O$ is completely cloudy. The $MgSO_4$ treated glass (right) appears as if it has been dusted completely with an adherent powder.

Example 6

Water Containing Water Soluble Magnesium Compound Removed Soap Scum

[0133] Surprisingly, rinsing a tile with hard water containing only added hardness ion (Mg^{2+}) removed soap scum from the tile.

Materials and Methods

[0134] A dilute mixture of coconut soap, hard water, and calcium carbonate was placed on a black ceramic tile and allowed to air dry. This was repeated five times, producing a heavily soiled tile. A first section of the soiled tile was immersed in unheated 17 grain hard water for about 1 minute. A second section of the soiled tile was immersed in unheated 17 grain hard water spiked with about 400 ppm of magnesium chloride. The middle section of the tile was not soaked after soiling.

Results

[0135] The portion of the tile that was immersed in hard water without magnesium ion showed considerable soap scum. The portion of the tile immersed in hard water containing 400 ppm magnesium chloride showed significantly less soap scum compared to the portions of the tile that were immersed only in hard water or untreated. The water containing water soluble magnesium compound without a builder or surfactant effectively removed soap scum.

[0136] The magnesium chloride was added to obtain a weight ratio of magnesium ion to calcium ion of 2:1 in the composition of water soluble magnesium ion. Surprisingly, a composition of a water soluble magnesium salt including magnesium ion in excess of calcium ion, will not only reduce or prevent formation of lime scale from hard water, but it will also remove soap scum.

Example 6

Water Soluble Magnesium Compound Reduced Streaking by Glass Cleaner

[0137] This Example demonstrates that washing a window with conventional glass cleaner formulation spiked with Mg^{2+} cleaned the window better than the conventional glass cleaner without the additional hardness ion.

Materials and Methods

[0138] One side of a window was washed with a commercially available glass cleaner. The other side was washed with the same commercially available glass cleaner containing 200 ppm water soluble magnesium salt, e.g., magnesium chloride.

Results

[0139] The left half of the window was cleaned with conventional glass cleaner with 200 ppm magnesium chloride. The right half of the window was cleaned with the same conventional glass cleaner without the addition of magnesium chloride. Streaking on the glass was greatly reduced with the addition of water soluble magnesium salt to the formula. Surprisingly, the composition of glass cleaner and water soluble magnesium salt cleaned the glass better than the glass cleaner alone.

Example 7

Water Soluble Magnesium Compound Removed Rust

[0140] Surprisingly, soaking a rusty object in water containing only added hardness ion (Mg^{2+}) removed rust from the object.

Materials and Methods

[0141] Pieces of rusty steel were placed in two beakers. One beaker contained 400 ppm magnesium chloride in 17 grain water. The other contained 17 grain water. After a couple of hours on the bench top, the pieces of steel were removed.

Results

[0142] The water in the beaker containing rusty steel in 400 ppm magnesium chloride in 17 grain water was rust colored. After soaking, the hard water contained some small pieces of rust, but was generally. The hard water did not dissolve rust. The water spiked with water soluble magnesium salt dissolved rust.

Example 8

Water Soluble Magnesium Compounds Protect Surfaces

[0143] This Example illustrates that water soluble magnesium compound (e.g., magnesium chloride) was found to protect a surface from hard water.

Materials and Methods

[0144] The contact angle of deionized water on ceramic tiles was studied. The tiles were first rinsed with a 1000 ppm solution of either magnesium chloride or magnesium sulfate and then wiped dry. The contact angle of deionized water on the tiles was measured and the tiles then rinsed with 17 grain hard water, wiped dry, and the contact angle of deionized water measured again.

Results

[0145]

	Water Contact Angle		
	before hard water rinse	after hard water rinse	ratio after/before
untreated	37	48	1.3
$MgCl_2$	21	28	1.3
$MgSO_4$	11	24	2.2

Discussion

[0146] It was hypothesized that the benefits of water soluble magnesium compounds might be a consequence of not only the water solubility of the potential calcium salts which could form in solution but also the interaction of the magnesium compound with calcium containing substrates such as glass and ceramic. To test this hypothesis, the contact angle of deionized water on ceramic tiles was studied. Improved protection of a calcium-containing substrate was indicated by reduced effect of a hard water rinse on the contact angle of water on the substrate. In other words, a lower ratio of the contact angle of water before and after hard water rinsing of the substrate correlates to improved protection of the substrate from hard water. The data demonstrates that magnesium chloride provided superior protection to a calcium-containing substrate such as a ceramic tile compared to magnesium sulfate.

Example 9

Solid Compositions of Water Soluble Magnesium Compound

[0147] Magnesium chloride was prepared as a cast solid block. Magnesium carbonate was prepared as a pressed solid.

Methods and Results

[0148] Solids can be prepared from powders or crystalline materials by melting and then transferring the molten material into a mold for solidification upon cooling. A solid block of magnesium chloride was made by heating magnesium chloride hexahydrate to its melting point of about 118° C. The molten salt was then transferred to a plastic container to afford a hard solid upon cooling to ambient temperature.

[0149] A solid block was made by compressing about 50 grams of magnesium carbonate monohydrate for about 20 seconds at about 1000 psi.

[0150] Although magnesium carbonate is water insoluble, a pressed block could also be made including both magnesium carbonate and a water soluble magnesium salt, such as magnesium chloride.

Discussion

[0151] A pressed or cast solid of a water soluble magnesium compound can be used, for example, for the treatment of potable water, for the treatment of a facility or home's overall water system, or for the treatment of water feed into a mechanical device such as a dishwasher, clothes washer, or car wash. By adding magnesium compound to the solid composition, when the composition is diluted to a use solution, the magnesium ions can reduce undesirable precipitation of cal-

cium salts. The magnesium can thus continually treat the equipment as the solid composition dissolves.

[0152] Magnesium chloride and magnesium sulfate meet the FDA's GRAS requirements and are approved as an unrestricted direct food additive. Not wishing to be bound by theory, it is believed that, in the pressed solid of magnesium carbonate, the water of hydration can be a binding agent in the block. For forming a cast solid from magnesium chloride, the presence of water of hydration (and additional water if desired) affords a reduced melting point compared to the anhydrous salt, allowing the temperature of the process to be reduced to a practical level.

[0153] The invention has been described with reference to various specific and preferred embodiments and techniques. However, it should be understood that many variations and modifications may be made while remaining within the spirit and scope of the invention.

We claim:

1. A method of cleaning ware comprising:

contacting the ware in an automatic warewashing machine with an aqueous composition consisting essentially of water and a water soluble magnesium salt;

wherein the aqueous composition during contacting comprises magnesium ion in a molar amount equal to or in excess over a molar amount of calcium ion;

recovering the ware with an acceptable amount of hard water spotting.

2. The method of claim **1**, wherein the aqueous composition is substantially free of an additional functional component selected from the group consisting essentially of a source of alkalinity, organic surfactant or cleaning agent, pH modifier, builder, processing aid, active oxygen compound, glass or metal corrosion inhibitor, activator, rinse aid functional material, bleaching agent, defoaming agent, anti-redeposition agent, stabilizing agent, enzyme, chelating agent, detersive polymer, softener, source of acidity, solubility modifier, bleaching agent, effervescent agent, and activator for the source of alkalinity, and any combination thereof.

3. The method of claim **1**, wherein the aqueous composition is substantially free of chelating agent, surfactant, and sheeting agent.

4. The method of claim **1**, wherein the water soluble magnesium salt comprises an anion that forms a soluble calcium salt.

5. The method of claim **1**, wherein an acceptable amount of hard water spotting comprises up to about one quarter of the surface spotted.

6. The method of claim **4**, wherein the water soluble magnesium salt is magnesium chloride.

7. The method of claim **1**, wherein:

the water soluble magnesium salt comprises an anion that forms a sparingly soluble calcium salt; and

the aqueous composition during contacting comprises magnesium ion in a molar amount equal to or greater than two-times the molar amount of calcium ion.

8. The method of claim **1**, wherein the water soluble magnesium salt is selected from the group consisting of magnesium acetate, magnesium benzoate, magnesium bromide, magnesium bromate, magnesium chlorate, magnesium chloride, magnesium chromate, magnesium citrate, magnesium formate, magnesium hexafluorosilicate, magnesium iodate, magnesium iodide, magnesium lactate, magnesium molybdate, magnesium nitrate, magnesium perchlorate, magnesium phosphinate, magnesium salicylate, magnesium sulfate, magnesium sulfite, magnesium thiosulfate, a hydrate thereof, and a mixture thereof.

9. The method of claim **1**, wherein the aqueous composition consists of water, water soluble magnesium salt, and a further ingredient selected from the group consisting of antimicrobial agent, viscosity modifier, aesthetic enhancing agent, lubricant, dispersant, preservative, thickener, and mixture thereof.

10. The method of claim **1**, wherein the aqueous composition consists of water and water soluble magnesium salt.

11. The method of claim **1**, wherein contacting comprises rinsing or presoaking ware.

12. The method of claim **1**, wherein contacting comprises rinsing or presoaking a medical instrument.

13. The method of claim **1**, further comprising reducing precipitation of calcium salt or reducing scaling or reducing solid deposits.

14. The method of claim **1**, wherein the aqueous composition during contacting comprises magnesium ion at a molar ratio of magnesium to calcium greater than or equal to one.

15. A method of cleaning a hard surface comprising:

contacting the hard surface with an aqueous composition consisting essentially of water and a water soluble magnesium salt;

wherein the aqueous composition during contacting comprises magnesium ion in a molar amount equal to or in excess over a molar amount of calcium ion;

achieving hard surface with an acceptable amount of hard water spotting.

16. The method of claim **15**, wherein the aqueous composition is substantially free of any additional functional component selected from the group consisting essentially of source of alkalinity, organic surfactant or cleaning agent, pH modifier, builder, processing aid, active oxygen compound, glass or metal corrosion inhibitor, activator, rinse aid functional material, bleaching agent, defoaming agent, anti-redeposition agent, stabilizing agent, enzyme, chelating agent, detersive polymer, softener, source of acidity, solubility modifier, bleaching agent, effervescent agent, activator for the source of alkalinity, and combinations thereof.

17. The method of claim **15**, wherein the aqueous composition is substantially free of chelating agent, surfactant, and sheeting agent.

18. The method of claim **15**, wherein the water soluble magnesium salt comprises an anion that forms a soluble calcium salt.

19. The method of claim **18**, wherein the water soluble magnesium salt is selected from the group consisting of magnesium acetate, magnesium benzoate, magnesium bromide, magnesium bromate, magnesium chlorate, magnesium chloride, magnesium chromate, magnesium citrate, magnesium formate, magnesium hexafluorosilicate, magnesium iodide, magnesium lactate, magnesium nitrate, magnesium perchlorate, magnesium phosphinate, magnesium sulfate, magnesium sulfite, magnesium molybdate, magnesium salicylate, magnesium thiosulfate, a hydrate thereof, and a mixture thereof.

20. The method of claim **18**, wherein the water soluble magnesium salt is magnesium chloride.

21. The method of claim **15**, wherein:

the water soluble magnesium salt comprises an anion that forms an sparingly soluble calcium salt; and

the aqueous composition during contacting comprises magnesium ion in a molar amount equal to or greater than two-times the molar amount of calcium ion.

22. The method of claim **15**, wherein an acceptable amount of hard water spotting comprises up to about one quarter of the surface containing spots.

23. The method of claim **15**, wherein the aqueous composition consists of water, water soluble magnesium salt, and a further ingredient selected from the group consisting of antimicrobial agent, viscosity modifier, aesthetic enhancing agent, lubricant, dispersant, preservative, thickener, and mixture thereof.

24. The method of claim **15**, wherein the aqueous composition consists of water and water soluble magnesium salt.

25. The method of claim **15**, further comprising reducing precipitation of calcium salt, scaling, or solid deposits.

26. The method of claim **15**, wherein the aqueous composition during contacting comprises magnesium ion at a molar ratio of magnesium to calcium greater than or equal to one.

27. The method of claim **15**, wherein contacting comprises rinsing the hard surface.

28. The method of claim **27**, wherein the hard surface is selected from the group consisting essentially of ceramic tile, a window, and a combination thereof.

29. The method of claim **15**, wherein the hard surface includes soap scum and contacting removes soap scum from the surface.

30. A method of cleaning ware comprising:

contacting the ware in an automatic warewashing machine with an aqueous composition consisting of water, a water soluble magnesium salt and a further ingredient selected from the group consisting of water, antimicrobial agent, viscosity modifier, aesthetic enhancing agent, lubricant, dispersant, preservative, thickener, or mixture thereof,

wherein the aqueous composition during contacting comprises magnesium ion in a molar amount equal to or in excess over a molar amount of calcium ion;

recovering the ware with an acceptable amount of hard water spotting.

31. The method of claim **30**, wherein the water soluble magnesium salt comprises an anion that forms a soluble calcium salt.

32. The method of claim **31**, wherein the water soluble magnesium salt is selected from the group consisting of magnesium acetate, magnesium benzoate, magnesium bromide, magnesium bromate, magnesium chlorate, magnesium chloride, magnesium chromate, magnesium citrate, magnesium formate, magnesium hexafluorosilicate, magnesium iodate, magnesium iodide, magnesium lactate, magnesium molybdate, magnesium nitrate, magnesium perchlorate, magnesium phosphinate, magnesium salicylate, magnesium sulfate, magnesium sulfite, magnesium thiosulfate, a hydrate thereof, and a mixture thereof.

33. The method of claim **31**, wherein the water soluble magnesium salt is magnesium chloride.

34. The method of claim **30**, wherein:

the water soluble magnesium salt comprises an anion that forms an insoluble calcium salt; and

the aqueous composition during contacting comprises magnesium ion in a molar amount equal to or greater than two-times the molar amount of calcium ion.

35. The method of claim **30**, wherein an acceptable amount of hard water spotting comprises up to about one quarter of the surface spotted.

36. The method of claim **30**, wherein the aqueous composition consists of water and water soluble magnesium salt.

37. A method of cleaning a hard surface comprising:

contacting the hard surface with an aqueous composition consisting of water, a water soluble magnesium salt and a further ingredient selected from the group consisting of water, antimicrobial agent, viscosity modifier, aesthetic enhancing agent, lubricant, dispersant, preservative, thickener, or mixture thereof,

wherein the aqueous composition during contacting comprises magnesium ion in a molar amount equal to or in excess over a molar amount of calcium ion;

achieving hard surface with an acceptable amount of hard water spotting.

38. The method of claim **37**, wherein the water soluble magnesium salt comprises an anion that forms a soluble calcium salt.

39. The method of claim **38**, wherein the water soluble magnesium salt is selected from the group consisting of magnesium acetate, magnesium benzoate, magnesium bromide, magnesium bromate, magnesium chlorate, magnesium chloride, magnesium chromate, magnesium citrate, magnesium formate, magnesium hexafluorosilicate, magnesium iodate, magnesium iodide, magnesium lactate, magnesium molybdate, magnesium nitrate, magnesium perchlorate, magnesium phosphinate, magnesium salicylate, magnesium sulfate, magnesium sulfite, magnesium thiosulfate, a hydrate thereof, and a mixture thereof.

40. The method of claim **38**, wherein the water soluble magnesium salt is magnesium chloride.

41. The method of claim **37**, wherein:

the water soluble magnesium salt comprises an anion that forms an insoluble calcium salt; and

the aqueous composition during contacting comprises magnesium ion in a molar amount equal to or greater than two-times the molar amount of calcium ion.

42. The method of claim **37**, wherein the aqueous composition consists of water and water soluble magnesium salt.

43. The method of claim **37**, wherein an acceptable amount of hard water spotting comprises up to about one quarter of the surface spotted.

44. A method of removing soap scum from an object, the method comprising:

contacting the soap scum on the object with an aqueous composition consisting essentially of water and a water soluble magnesium salt;

removing soap scum from the object.

45. The method of claim **44**, wherein removing the soap scum results in a shiny surface.

46. The method of claim **44**, wherein the soap scum comprises calcium salt of fatty acid, triglyceride, and protein.

47. A method of removing soap scum from an object, the method comprising:

contacting the soap scum on the object with an aqueous composition consisting of water, a water soluble magnesium salt and a further ingredient selected from the group consisting of water, antimicrobial agent, viscosity modifier, aesthetic enhancing agent, lubricant, dispersant, preservative, thickener, or mixture thereof,

removing soap scum from the object.

48. An aqueous hard surface cleaner consisting essentially of water and a water soluble magnesium salt;

wherein upon dilution for use as a hard surface cleaner the composition comprises the magnesium ion in a molar amount equal to or in excess over a molar amount of calcium ion; and

the composition is substantially free of chelating agent, surfactant, and sheeting agent.

49. The composition of claim **48**, wherein the composition is substantially free of any component selected from the group consisting essentially of source of alkalinity, organic surfactant or cleaning agent, pH modifier, builder, processing aid, active oxygen compound, glass or metal corrosion inhibitor, activator, rinse aid functional material, bleaching agent, defoaming agent, anti-redeposition agent, stabilizing agent, enzyme, chelating agent, detersive polymer, softener, source of acidity, solubility modifier, bleaching agent, effervescent agent, and activator for the source of alkalinity, and any combination thereof.

50. The composition of claim **48**, wherein the water soluble magnesium salt comprises an anion that forms a soluble calcium salt.

51. The method of claim **48**, wherein the water soluble magnesium salt is selected from the group consisting of magnesium acetate, magnesium benzoate, magnesium bromide, magnesium bromate, magnesium chlorate, magnesium chloride, magnesium chromate, magnesium citrate, magnesium formate, magnesium hexafluorosilicate, magnesium iodate, magnesium iodide, magnesium lactate, magnesium molybdate, magnesium nitrate, magnesium perchlorate, magnesium phosphinate, magnesium salicylate, magnesium sulfate, magnesium sulfite, magnesium thiosulfate, a hydrate thereof, and a mixture thereof.

52. The composition of claim **48**, wherein the composition consists of water and water soluble magnesium salt.

53. The composition of claim **48**, wherein the composition consists essentially of water, water soluble magnesium salt, and a further ingredient selected from the group consisting of antimicrobial agent, viscosity modifier, aesthetic enhancing agent, lubricant, dispersant, preservative, thickener, or mixture thereof.

54. The composition of claim **48**, wherein the water soluble magnesium salt is magnesium chloride.

55. The composition of claim **48**, wherein upon dilution for use the composition comprises the magnesium ion at a wt-% greater than or equal to one half times a wt-% of calcium ion.

56. The composition of claim **48**, wherein:

the water soluble magnesium salt comprises an anion that forms a sparingly soluble calcium salt; and

the aqueous composition, upon dilution for use, comprises magnesium ion in a molar amount equal to or greater than two-times the molar amount of calcium ion.

57. A composition for cleaning ware consisting essentially of water and a water soluble magnesium salt;

wherein upon dilution for use cleaning ware, the composition comprises the magnesium ion in a molar amount equal to or in excess over a molar amount of calcium ion; and

the composition is substantially free of chelating agent, surfactant, and sheeting agent.

58. The composition of claim **57**, wherein the composition is substantially free a component selected from the group consisting essentially of source of alkalinity, organic surfactant or cleaning agent, pH modifier, builder, processing aid, active oxygen compound, glass or metal corrosion inhibitor, activator, rinse aid functional material, bleaching agent, defoaming agent, anti-redeposition agent, stabilizing agent, enzyme, chelating agent, detersive polymer, softener, source of acidity, solubility modifier, bleaching agent, effervescent agent, activator for the source of alkalinity, and combinations thereof.

59. The composition of claim **57**, wherein the water soluble magnesium salt comprises an anion that forms a soluble calcium salt.

60. The method of claim **57**, wherein the water soluble magnesium salt is selected from the group consisting of magnesium acetate, magnesium benzoate, magnesium bromide, magnesium bromate, magnesium chlorate, magnesium chloride, magnesium chromate, magnesium citrate, magnesium formate, magnesium hexafluorosilicate, magnesium iodate, magnesium iodide, magnesium lactate, magnesium molybdate, magnesium nitrate, magnesium perchlorate, magnesium phosphinate, magnesium salicylate, magnesium sulfate, magnesium sulfite, magnesium thiosulfate, a hydrate thereof, and a mixture thereof.

61. The composition of claim **57**, wherein the composition consists of water and water soluble magnesium salt.

62. The composition of claim **57**, wherein the water soluble magnesium salt is magnesium chloride.

63. The composition of claim **57**, wherein upon dilution for use the composition comprises the magnesium ion at a molar ratio of magnesium to calcium greater than or equal to one.

64. The composition of claim **57**, wherein:

the water soluble magnesium salt comprises an anion that forms a sparingly soluble calcium salt; and

the aqueous composition, upon dilution for use, comprises magnesium ion in a molar ratio of magnesium to calcium equal to or greater than one.

65. An aqueous hard surface cleaner consisting of water, a water soluble magnesium salt, and a further ingredient selected from the group consisting of water, antimicrobial agent, viscosity modifier, aesthetic enhancing agent, lubricant, dispersant, preservative, thickener, or mixture thereof,

wherein upon dilution for use as a hard surface cleaner the composition comprises the magnesium ion in a molar amount equal to or in excess over a molar amount of calcium ion.

66. The composition of claim **65**, wherein the water soluble magnesium salt comprises an anion that forms a soluble calcium salt.

67. The method of claim **65**, wherein the water soluble magnesium salt is selected from the group consisting of magnesium acetate, magnesium benzoate, magnesium bromide, magnesium bromate, magnesium chlorate, magnesium chloride, magnesium chromate, magnesium citrate, magnesium formate, magnesium hexafluorosilicate, magnesium iodate, magnesium iodide, magnesium lactate, magnesium molybdate, magnesium nitrate, magnesium perchlorate, magnesium phosphinate, magnesium salicylate, magnesium sulfate, magnesium sulfite, magnesium thiosulfate, a hydrate thereof, and a mixture thereof.

68. The composition of claim **65**, wherein the composition consists of water and water soluble magnesium salt.

69. The composition of claim **65**, wherein the water soluble magnesium salt is magnesium chloride.

70. The composition of claim **65**, wherein upon dilution for use the composition comprises the magnesium ion at a molar ratio of magnesium to calcium greater than or equal to one.

71. The composition of claim **65**, wherein:
the water soluble magnesium salt comprises an anion that forms an insoluble calcium salt; and
the aqueous composition, upon dilution for use, comprises magnesium ion in a molar amount equal to or greater than two-times the molar amount of calcium ion.

72. A composition for cleaning ware consisting of water, a water soluble magnesium salt, and a further ingredient selected from the group consisting of water, antimicrobial agent, viscosity modifier, aesthetic enhancing agent, lubricant, dispersant, preservative, thickener, or mixture thereof,
wherein upon dilution for use as a hard surface cleaner the composition comprises the magnesium ion in a molar amount equal to or in excess over a molar amount of calcium ion.

73. The composition of claim **72**, wherein the water soluble magnesium salt comprises an anion that forms a soluble calcium salt.

74. The method of claim **72**, wherein the water soluble magnesium salt is selected from the group consisting of magnesium acetate, magnesium benzoate, magnesium bromide, magnesium bromate, magnesium chlorate, magnesium chloride, magnesium chromate, magnesium citrate, magnesium formate, magnesium hexafluorosilicate, magnesium iodate, magnesium iodide, magnesium lactate, magnesium molybdate, magnesium nitrate, magnesium perchlorate, magnesium phosphinate, magnesium salicylate, magnesium sulfate, magnesium sulfite, magnesium thiosulfate, a hydrate thereof, and a mixture thereof.

75. The composition of claim **72**, wherein the composition consists of water and water soluble magnesium salt.

76. The composition of claim **72**, wherein the composition consists essentially of water, water soluble magnesium salt, and a further ingredient selected from the group consisting of antimicrobial agent, viscosity modifier, aesthetic enhancing agent, lubricant, dispersant, preservative, thickener, or mixture thereof.

77. The composition of claim **72**, wherein the water soluble magnesium salt is magnesium chloride.

78. The composition of claim **72**, wherein upon dilution for use the composition comprises the magnesium ion at a wt-% greater than or equal to one half times a wt-% of calcium ion.

79. The composition of claim **72**, wherein:
the water soluble magnesium salt comprises an anion that forms an insoluble calcium salt; and
the aqueous composition, upon dilution for use, comprises magnesium ion in a molar amount equal to or greater than two-times the molar amount of calcium ion.

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