United States Patent

Sabatelli et al.

[15] **3,671,440**

[45] **June 20, 1972**

[54] PROCESS OF CLEANING

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[22] Filed: **Jan. 16, 1970**

[21] Appl. No.: **3,520**

[52] **U.S. Cl.** **252/103,** 252/99, 252/187

[51] **Int. Cl.** **C11d 7/54**

[58] **Field of Search** 252/99, 103, 187

[56] **References Cited**

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[57] **ABSTRACT**

Concentrates of liquid chlorine containing machine dishwashing compositions are disclosed which include alkali metal hydroxide, a tetra-alkali metal pyrophosphate, a water-soluble polymer, an alkali metal hypochlorite and an aqueous carrier liquid or vehicle. These concentrates have improved long lasting hard water tolerance. Cooking and eating utensils may be cleaned by dilute solutions of the present machine dishwashing compositions in water having hardness as high as 20 grains per gallon or more with less spotting and greater clarity.

6 Claims, No Drawings

PROCESS OF CLEANING

This invention relates to liquid dishwashing concentrates which effectively remove food soils from glassware, dishes and the like with less spotting and greater clarity. More particularly, the present invention provides new liquid dishwashing compositions which include an alkali metal hydroxide, a tetra-alkali metal pyrophosphate, a water-soluble polymer, an alkali metal hypochlorite and an aqueous carrier liquid. The compositions have high, long lasting water hardness tolerance, and are also effective for descaling uses.

Heretofore, strongly alkaline solutions have been used in institutional and household dishwashing machines for washing dishware, glasses, and other cooking and eating utensils. Ordinary tap water is customarily used with the cleaning composition to form a cleaning solution and for rinsing purposes subsequent to the cleaning operation. As is well known, spotting on dishes and glassware by inorganic salt residues and precipitates may be a major problem. Deposit formation may also interfere with the operation of the washing equipment by requiring frequent maintenance. Condensed phosphates (also commonly referred to as polyphosphates) have been used in these cleaning compositions, but at elevated solution temperatures rapid hydrolysis typically results and the deposition of orthophosphate precipitates occurs.

Use of various polyelectrolytes in conjunction with organic detergents has been disclosed in British specification, Nos. 451,342 and 1,073,947 and in U.S. Pat. No. 3,308,067. However, in these systems polyelectrolytes have been used in conjunction with organic soaps and detergents in substantially neutral systems where foaming is desirable. Thus, these patents do not provide alkaline, low foaming detergent systems.

Generally stated, the concentrated liquid chlorine-containing machine dishwashing compositions of this invention comprise from about 5 to about 25 parts by weight of an alkali metal hydroxide; from about 0.1 to about 7.0 parts by weight of alkali metal hypochlorite; from about 0 to about 20 parts by weight of a tetra-alkali metal pyrophosphate; from about 1 to about 10 parts by weight of a water-soluble acrylic polymer having a molecular weight of from 1,000 to 15,000,000; and from about 25 to about 75 parts by weight of an aqueous carrier liquid or vehicle. The aforestated amounts of the various ingredients (except the liquid vehicle) are expressed on a dry weight basis.

The alkali metal hydroxide in the present dishwashing compositions may be sodium hydroxide, potassium hydroxide or mixtures thereof. Preferably the amount of alkali metal hydroxide is from about 10 to about 20 parts by weight, dry weight basis. Other alkaline materials such as sodium or potassium carbonate, or sodium or potassium orthophosphates may be substituted to a limited extent for some of the hydroxide if desired. These other alkaline materials individually or in combination may be used to replace up to about 50 weight percent of the alkali metal hydroxide. Preferably potassium hydroxide is used as the sole alkaline component.

The tetra-alkali metal pyrophosphate component of the present invention may include any alkali metal such as sodium or potassium. The preferred condensed phosphate is tetra potassium pyrophosphate. The preferred amount of tetra-alkali metal pyrophosphate is from about 5 to about 15 parts by weight, dry weight basis.

The alkali metal hypochlorite component of the present invention may include most any alkali metal with sodium hypochlorite being preferred. The preferred amount of alkali metal hypochlorite is from about 0.5 to about 5 parts by weight, dry weight basis.

The water soluble acrylic polymer used in the compositions of the present invention can be polyacrylic acid, polymethacrylic acid, acrylic acid-methacrylic acid copolymers, hydrolyzed polyacrylamide, hydrolyzed polymethacrylamide, hydrolyzed acrylamide-methacrylamide copolymers, hydrolyzed polyacrylonitrile, hydrolyzed polymethacrylonitrile, hydrolyzed acrylonitrile-methacrylonitrile copolymers, or mixtures of any two or more

of the said polymers. Water-soluble salts of these polymers, or polymer mixtures; such as the respective alkali metal (e.g., sodium, potassium), ammonium or amine salts; can also be used. The weight average molecular weight of the polymers is from about 1,000 to about 15,000,000 and is preferably within the range of from 1,000 to 120,000. The preferred polymer is polyacrylic acid or sodium polyacrylate having a weight average molecular weight within the range of 80,000 to 120,000. These polymers are commercially available, and methods for their preparation are well known in the art. The polymer or salt is preferably used in an amount of from about 1 to about 8 parts by weight, dry weight basis.

The carrier vehicle for the liquid concentrates of this invention is usually water but may be an aqueous liquid containing water and a cosolvent such as a lower alkanol (e.g., propanol) or glycol (e.g., propylene glycol). The concentrates may also contain a small amount of a dispersing agent if desirable. Preferably, the liquid concentrates of the invention contain from about 50 to about 75 percent water or other aqueous carrier vehicle liquid.

The concentrates may also include other typical adjuvants such as dyes.

A preferred liquid machine dishwashing concentrate in accordance with this invention is shown below.

	Parts by Weight, dry weight basis
Potassium hydroxide	14.7
Tetra-potassium pyrophosphate	6
Sodium hypochlorite	3
Sodium polyacrylate (molecular weight 80–120,000)	2.5

In the process of this invention, an aqueous cleaning solution containing from about 0.05 to about 1 and preferably from about 0.05 to about 0.5 weight percent of the above concentrate is prepared having a temperature of from about 140° Fahrenheit to about 200° Fahrenheit, and preferably from about 140° Fahrenheit to about 160° Fahrenheit. This cleaning solution is applied to the surfaces of articles to be cleaned. Although any technique can be used for applying the cleaning solution of the concentrate to the fouled surfaces, it is specifically designed for and is highly effective when used in cleaning cooking and eating utensils. Highly effective cleaning with low foaming is obtained in institutional dishwashing machines with solutions prepared from the concentrates. After cleaning, the articles are rinsed with water, and dried.

Solutions of the dishwashing compositions of this invention are highly effective in removing food soils and residues from dishes, glassware, and other cooking and eating utensils in conventional dishwashing machines. Not only are the food residues more effectively removed with the present composition, but also the cleaned dishes and glassware exhibit less spotting and greater clarity than with conventional cleaning compositions. These solutions are also effective for descaling scaled dinnerware, glassware, etc. Excellent cleaning and/or descaling results are obtained with cleaning solutions made with waters whose hardness ranges up to 15 to 20 grains per gallon or more.

This invention is further illustrated by the following specific but non-limiting examples. In the examples all parts are parts by weight unless otherwise specifically indicated.

EXAMPLE I

This example illustrates the improved hard water tolerance of the liquid machine dishwashing cleaning solutions of this invention as compared with solutions of a typical known machine dishwashing composition and a composition like the ones which are the subject of the present invention but without an acrylic polymer. The concentrates tested had the following compositions, in parts by weight.

Ingredient	Example 1A	1B	1C
Water (deionized or softened)	35	38	28
Potassium Hydroxide (45–47% aqueous solution)	32	32	32
Tetrapotassium Pyrophosphate (60% aqueous solution)	20	10	10
Sodium Tripolyphosphate	13	—	—
Sodium Polyacrylate (25% aqueous solution average molecular weight of 80–100,000)	—	—	10
Sodium Hypochlorite (15% aqueous solution)	—	20	20

The products were tested for water hardness tolerance by preparing diluted 0.3 weight percent cleaning solutions of each of the above concentrates in deionized water, and in waters synthetically hardened by the addition of calcium acetate to provide hardness values of 5, 10, 15, and 20 grains of hardness as calcium carbonate per gallon. The respective solutions were poured in 27 × 275 millimeter glass cylinders. At the end of 24 hours the depth of floc was measured in the bottom of each test cylinder signifying the degree of water hardness tolerance. All tests were run at room temperature. Results are shown in Table I.

TABLE I

GRAINS PER GALLON OF WATER HARDNESS

Example	0	5	10	15	20
1A	no floc	no floc	no floc	41 mm	37 mm
1 B	no floc	41 mm	41 mm	41 mm	41 mm
1C	no floc	no floc	no floc	no floc	9 mm

As seen in the table, cleaning solutions of the conventional liquid machine dishwashing produce of Example 1A normally will not tolerate more than 10 to 15 grains per gallon of water hardness. In contrast, solutions of the liquid concentrates of the present invention, as typified by Example 1C, tolerate hardness greater than 15 grains per gallon and also provide better inhibition of hard water salt deposits as evidenced by significantly lower floc depths in the tests employing 20 grain hardness water. The solutions of Example 1B, having no sodium polyacrylate, will not tolerate any significant water hardness. Therefore, it can be seen that the inclusion of 2 percent dry basis sodium polyacrylate in Example 1C provides the increased hard water tolerance.

EXAMPLE 2

The descaling ability of the composition of Example 1C was compared with that of the composition of Example 1A.

In normal machine dishwashing operations existing scale deposits can be removed only if the dishwashing product being used has a water hardness tolerance greater than that of the water hardness present in its water of solution. When greater tolerance exists the calcium and magnesium salts comprising the scale will dissolve until the excess tolerance is used up by the amounts dissolved. Use of the products of the present invention permits scale removal at concentrations far beyond the normal stoichiometic level of calcium and magnesium control.

The typical prior art product of Example 1A has a calculated water hardness tolerance; in a 0.3 weight percent solution, of 6.5 to 7.5 grains per gallon. When the cleaning solution make-up water has a hardness beyond this level no descaling takes place and actually a buildup of insoluble calcium and magnesium salt scale occurs.

The product of Example 1C has a calculated hardness tolerance, in a 0.3 weight percent solution of less than 1 grain per gallon provided by the tetrapotassium pyrophosphate. However, in actual practice this product exhibits descaling effects in dilute cleaning solutions made with water having hardness of up to 15 to 20 grains per gallon.

In order to illustrate the foregoing, 10 ounce glass water tumblers were filled with 10 grain per gallon tap water and held at 100° C. until the water was evaporated leaving behind a tenacious hard water scale which cannot be physically removed. To test the scale removal properties of the compositions under conditions close to actual operating conditions, a closely controlled device was built which employs a 4 liter reservoir held at a temperature of 150° ± 2° Fahrenheit. From this reservoir the test solution is pumped through a single spray nozzle which is directed into the interior of the test glass which is clamped in an inverted position directly over the spray. The solution is collected and recirculated. The duration of the test is 15 minutes of spray followed by a 15 second rinse with distilled water and an air drying.

The liquid concentrates of Examples 1A and 1C were made and tested in the descaling test, using 10 grain water to prepare the 0.3 weight percent test solutions. The product of Example 1A removed no scale. The product of Example 1C removed 30 to 40 percent of the scale on the test glass. Six weeks later the experiment was repeated with the same result attesting to the storage stability of the product of Example 1C, typifying the liquid concentrates of this invention.

What is claimed is:

1. A process for cleaning an article fouled with food or cooking soil which consists of:

A. adding to water having a hardness of up to about 20 grains per gallon about 0.05 to about 1.0 weight percent of a liquid dishwashing concentrate consisting essentially of

a. from about 5 to about 25 parts by weight of an alkali metal hydroxide,

b. from about 0 to about 20 parts by weight of a tetra-alkali metal pyrophosphate,

c. from about 0.1 to about 7.0 parts by weight of an alkali metal hypochlorite,

d. from about 1 to about 10 parts by weight of a water-soluble acrylic polymer having a molecular weight of from 1,000 to 15,000,000 selected from the group consisting of polyacrylic acid, polymethacrylic acid, acrylic acid-methacrylic acid copolymers, hydrolyzed polyacrylamide, hydrolyzed polymethacrylamide, hydrolyzed acrylamide-methacrylamide copolymers, hydrolyzed polyacrylonitrile, hydrolyzed polymethacrylonitrile, hydrolyzed acrylonitrile-methacrylonitrile copolymers or mixtures of said polymers, or of a water soluble salt of the said polymers or polymer mixtures; and

e. from about 25 to about 75 parts by weight of an aqueous vehicle for said ingredients (a) through (d), said vehicle selected from the group consisting of water, mixtures of water with a lower alkanol and mixtures of water with a glycol cosolvent;

B. applying the aqueous cleaning solution of (A) to the article fouled with food or cooking soil

C. rinsing the article free of the aqueous solution of (A), and

D. drying the rinsed article.

2. The process of claim 1 wherein the alkali metal hydroxide is potassium hydroxide, the tetra-alkali metal pyrophosphate is tetra-potassium pyrophosphate, the alkali metal hypochlorite is sodium hypochlorite, and the water-soluble acrylic polymer is the sodium salt of a polyacrylic acid having a molecular weight of about 80,000 to 100,000.

3. The process of claim 1 wherein

a. the alkali metal hydroxide is present in an amount from about 10 to about 20 parts by weight,

b. the tetra-alkali metal pyrophosphate is present in an amount from about 5 to about 15 parts by weight,

c. the alkali metal hypochlorite is present in an amount from about 0.5 to about 5.0 parts by weight,

d. the water-soluble acrylic polymer is present in an amount from about 1 to about 8 parts by weight, and

e. the aqueous vehicle is present in an amount from about 50 to about 75 parts by weight.

4. The process of claim 1 wherein the Step (A) addition is about 0.3 weight percent of said liquid dishwashing concentrate which is added to said water.

5. The process of claim 3 wherein the alkali metal hydroxide is potassium hydroxide, the tetra-alkali metal pyrophosphate is tetra-potassium pyrophosphate, the alkali metal hypochlorite is sodium hypochlorite, and the water-soluble acrylic polymer is the sodium salt of polyacrylic acid having a molecular weight of about 80,000 to 100,000.

6. The process of claim 5 wherein there is about 73.8 weight percent deionized water and, on a dry weight basis, about 14.7 weight percent potassium hydroxide, about 6 weight percent tetra-potassium pyrophosphate, about 3 weight percent sodium hypochlorite and about 2.5 weight percent sodium polyacrylate.

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