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DETERGENT COMPOSITIONS

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This invention relates to detergent compositions which are particularly useful in dishwashing applications and which comprise an alkaline detergent salt, an alkaline condensed phosphate salt and chlorinated trisodium phosphate.

It is a recognized problem in the dishwashing art that ceramic and plastic dinnerware, particularly cups, saucers and teapots, under use conditions, develop objectionable stains thereon. Such stained dinnerware must be frequently bleached with solutions of strong oxidizing agents, such as hypochlorites and peroxides. The necessity of frequent bleaching entails additional labor and the handling of strong bleach solutions. In addition, the oxidizing solutions employed may attack the surfaces of the dinnerware, or alter the pigments used for coloration.

It is an object of this invention to prepare detergent compositions for dishwashing applications which are characterized by improved detergency and the ability to prevent or retard the formation of objectionable stains on dinnerware.

Other objects of the present invention will become apparent from the following detailed description thereof.

It has been discovered that compositions comprising an alkaline detergent salt, an alkaline condensed phosphate salt and chlorinated trisodium phosphate are excellent detergents, especially for dishwashing applications, and inhibit the development of stains on plastic and china dinnerware. The detergent compositions of this invention are composed of the following proportions of the individual components:

Component	Concentration	
	Operable Range	Preferred Range
	Percent	*Percent*
Alkaline detergent salt	20–70	40–60
Alkaline condensed phosphate salt	15–60	30–50
Chlorinated trisodium phosphate	5–25	5–15

As used in this application, the term "alkaline detergent salt" includes the di- and tri-sodium orthophosphates, sodium carbonate, sodium bicarbonate, modified sodas (combinations of sodium carbonate and sodium bicarbonate, partially hydrated in general), sodium silicates (ortho-, meta-, and sesqui-silicate and water glasses) and the sodium borates (borax and meta-borate). The term "alkaline condensed phosphate" is used to designate tetrasodium pyrophosphate and those polyphosphates of the calcium and magnesium ion sequestering type whose Na_2O/P_2O_5 ratios range from 1:1 to 1.67:1. The term "chlorinated trisodium phosphate" is used to designate a composition consisting of trisodium phosphate and sodium hypochlorite in intimate association in a crystalline form. The chlorinated trisodium phosphate may contain from 1 to 5% available chlorine, and may be prepared by the methods of U. S. 1,555,474 or U. S. 1,965,304, or modifications thereof.

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The following examples are set forth to more clearly illustrate the principles and practice of this invention to those skilled in the art.

Example 1

A field test was run at a large institution using plastic dinnerware and washing it in a mechanical dishwashing machine. Prior to this test, the dishes were washed with a proprietary dishwashing compound and bi-weekly bleaching of cups and saucers was required to remove stains therefrom. These dishes were destained and washed exclusively with the following detergent composition for a three month period:

50% sodium meta-silicate pentahydrate
40% sodium tripolyphosphate
10% chlorinated trisodium phosphate (3% available chlorine)

During the entire three month test period, no bleaching of the dinnerware was required. Upon returning temporarily to the use of the regular proprietary dishwashing compound, characteristic stain development resumed and bi-weekly bleaching of the cups and saucers was again required.

Example 2

A field test analogous to that of Example 1 was run at a second institution that used china dinnerware. During the three month period of the test, when the detergent composition set forth in Example 1 was used, substantial reduction of staining and film development was noticed immediately, and no bleaching of the dinnerware was required, whereas constant bleaching of cups, saucers and teapots had been necessary with the proprietary dishwashing compound used immediately preceding this test.

Example 3

Several badly stained plastic cups were divided into two groups. The first group was soaked in a 5% solution of a detergent composition of this invention comprising 50% sodium metasilicate

pentahydrate, 40% sodium tripolyphosphate and 10% chlorinated trisodium phosphate (3% available chlorine) at 140° F. At the end of two hours the stains were completely removed.

In marked contrast to the above noted results, a six hour soaking period was required to remove the stain in the second group when a sodium hypochlorite solution was used at the same active chlorine level. In addition, the sodium hypochlorite solution attacked abrasion marks in the plasticware as evidenced by a distinct lemon colored tint at the points of abrasion. As distinguished from the above-noted results, the detergent composition of this invention had little or no noticeable effect upon the plasticware itself.

Example 4

The following detergent composition was prepared:

Component:	Concentration, per cent
Sodium metasilicate pentahydrate	70
Sodium tripolyphosphate	25
Chlorinated trisodium phosphate	5

A segment of a badly stained melamine plastic cup was soaked in a 5% solution of the above detergent composition at 140° F. and was destained in about 1.5 hours. Another segment of the same cup was destained within 16 hours by overnight soaking in a 5% solution of the detergent composition at about 70° F.

The above described detergent composition was employed in a home dishwashing machine at a 0.5% concentration. The composition had outstanding detergent properties, and was characterized in that glassware, in particular, dried sparklingly clean.

Example 5

The following detergent composition was prepared:

Component:	Concentration, per cent
Sodium metasilicate pentahydrate	20
Sodium carbonate	10
Commercial trisodium phosphate, hydrated	5
Sodium tripolyphosphate	20
Tetrasodium pyrophosphate	20
Chlorinated trisodium phosphate	25

When tested at 140° F., as described in Example 4, the detergent composition removed all stains from the plastic segment in 0.5 hour. At 70° F., all stain was removed from another plastic segment within 16 hours by an overnight soaking in a 5% solution of the detergent composition.

The detergent composition was tested in a home dishwashing machine, as described in Example 4, and had excellent detergent properties.

Example 6

The following detergent composition was prepared:

Component:	Concentration, per cent
Sodium metasilicate pentahydrate	30
Sodium tripolyphosphate	60
Chlorinated trisodium phosphate	10

The destaining action of the above noted detergent composition was determined as in Example 4. At 140° F., one hour was required to destain the plastic. At 70° F., all stain was removed from the plastic within 16 hours by an overnight soaking.

This composition is an excellent detergent for use in mechanical dishwashing machines, particularly where unusually hard water is encountered.

An outstanding feature of the compositions of the present invention is that, when employed at normal use concentrations, they prevent the development of objectionable stains and films on either plastic or china dinnerware. The reasons for the remarkable stain inhibiting action of the detergent compositions of this invention are not known, but it appears to be a unique, inherent characteristic of these compositions. It has been established, however, that the presence of available chlorine alone in a dishwashing composition is insufficient to inhibit the aforesaid staining action. For example, when 10% trisodium phosphate and sufficient Chloramine T (sodium p-toluene-sulfochloramine) to give an equivalent concentration of available chlorine was substituted for the chlorinated trisodium phosphate in the detergent composition described in Example 1, the detergent composition did not inhibit the formation of objectionable stains.

As noted in Examples 3–6, inclusive, when used in relatively high concentrations, the detergent compositions of this invention will remove stains from plastic dinnerware. As clearly set forth in Example 3, the detergent compositions of this invention are more effective than sodium hypochlorite for this purpose, when both compositions are employed at the same active chlorine level. In addition, although the compositions of this invention are strong bleaching agents, they have little or no deleterious effect upon the plastic dinnerware, as compared with sodium hypochlorite solutions at the same available chlorine level.

The compositions of this invention are excellent detergents and remove fats and other tenacious food stains rapidly and thoroughly. An outstanding feature of the detergents of the present invention is that glassware and dinnerware washed therein rinse exceptionally well and dry sparklingly clean without hand towelling. This feature is exceptionally important in detergent compositions designed for institutional use.

It is essential that the alkaline detergent salt, the alkaline condensed phosphate salt and the chlorinated trisodium phosphate be present within carefully controlled limits to obtain detergent compositions which have good detergency and the property of preventing the development of objectionable stains. As is well known in the art, water conditions, particularly its hardness, have a profound effect upon the efficiency of detergent compositions and accordingly the compositions of the present invention may be varied within the operable and preferred limits previously set forth to obtain optimum properties under widely varying dishwashing conditions. The chlorinated trisodium phosphate must be present to the extent of at least 5% to retard the development of stains under normal dishwashing conditions. In order to avoid alteration of the colors of plastic ware when the detergent is used as a destaining agent the chlorinated trisodium phosphate should not be used at concentrations above 25%, and the preferred range is from 5–15%. The condensed phosphate salts function as sequestering agents and the concentration required for good detergency is a function of the water hardness that is to be encountered. For general use it has been found that 30–50% of condensed phosphate gives optimum results. The balance of the detergent composition is an alkaline detergent salt selected from the group previously

set forth. Of this group of detergent salts, the preferred compound is sodium metasilicate because of its excellent detergent properties and because it ameliorates the solubilizing action of polyphosphates on non-ferrous metals.

As is well known in the art, active chlorine compounds are destroyed upon prolonged exposure to the atmosphere. For this reason, the detergent compositions of this invention should be stored in tight containers, or in moderately humid atmospheres. The composition should be stored at temperatures not substantially above 75° F.

We claim:

1. A detergent composition consisting essentially of 20–70% of an alkaline detergent salt selected from the group consisting of sodium carbonate, sodium bicarbonate, modified soda, disodium orthphosphate, trisodium orthophosphate, sodium metasilicate, sodium sesquisilicate, water glass, borax and sodium borate, 15–60% of an alkaline condensed phosphate salt selected from the group consisting of tetrasodium pyrophosphate and those polyphosphates of the calcium and magnesium ion sequestering type whose Na_2O/P_2O_5 ratios range from 1:1 to 1.67:1, and 5–25% chlorinated trisodium phosphate.

2. A detergent composition consisting essentially of 40–60% of an alkaline detergent salt selected from the group consisting of sodium carbonate, sodium bicarbonate, modified soda, disodium orthophosphate, trisodium orthophosphate, sodium metasilicate, sodium sequisilicate, water glass, borax and sodium borate, 30–50% of an alkaline condensed phosphate salt selected from the group consisting of tetrasodium pyrophosphate and those polyphosphates of the calcium and magnesium ion sequestering type whose Na_2O/P_2O_5 ratios range from 1:1 to 1.67:1, and 5–15% chlorinated trisodium phosphate.

3. A detergent composition consisting essentially of 20–70% sodium metasilicate, 15–60% sodium tripolyphosphate and 5–25% chlorinated trisodium phosphate.

4. A detergent composition consisting essentially of 40–60% sodium metasilicate, 30–50% sodium tripolyphosphate and 5–15% chlorinated trisodium phosphate.

5: A detergent composition consisting of 50% sodium metasilicate, 40% sodium tripolyphosphate and 10% chlorinated trisodium phosphate.

6. A detergent composition consisting of 70% sodium metasilicate, 25% sodium tripolyphosphate and 5% chlorinated trisodium phosphate.

7. A detergent composition consisting of 30% sodium metasilicate, 60% sodium tripolyphosphate and 10% chlorinated trisodium phosphate.

8. A detergent composition consisting of 20% sodium metasilicate, 10% sodium carbonate, 5% trisodium phosphate, 20% sodium tripolyphosphate, 20% tetrasodium pyrophosphate and 25% chlorinated trisodium phosphate.

9. The method of washing plastic and vitreous dinnerware which comprises subjecting the dinnerware to the washing action of an aqueous solution of the composition of claim 1 in a dishwashing machine.

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