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ABRASIVE DETERGENT COMPOSITION

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This invention relates to abrasive detergent compositions useful in cleaning, scouring and polishing objects in general, for example, cleaning and polishing the teeth, polishing metallic objects such as silverware, or cleaning walls or other surfaces.

This application is a continuation-in-part of my copending application Serial No. 721,316, filed April 19, 1934.

Abrasive detergent compositions used for cleaning and polishing purposes contain an abrasive and also a detergent which may be soap or an alkali, or both, depending upon the particular use of the composition. The type of abrasive which has been used in such compositions is one which is insoluble in water or other liquid used with the composition. These insoluble abrasives, although necessary for imparting a scouring action to the composition, are objectionable in that it is difficult to wash them off from the surface after the cleaning operation. They tend to dry on the surfaces to which they have been applied, forming visible films of insoluble material.

I have found that this objection may be overcome by employing a suitable type of abrasive whose solubility rate in water solutions of the composition is sufficiently low so as to permit effective scouring or polishing before it has dissolved. In addition to a certain type of abrasive, it is also necessary that the composition contain a material whose water solution has the effect of slowly dissolving the abrasive. I have found that by the proper selection of abrasive and detergent, a compositon may be produced in which the solvent effect of a water solution of the detergent on the abrasive is slow enough so that the abrasive is effective in performing its scouring function and yet is fast enough so that after the scouring function is performed, the abrasive has been dissolved so that it may be easily rinsed from the surface. The detergent present need not be in sufficient quantity to completely dissolve all of the abrasive since even the ability to dissolve a small quantity of the abrasive is of value in removing the abrasive from the surfaces to be cleansed. The partial dissolving effect prevents the adherence of the abrasive particles to the surface being cleaned and enables them to be washed away more readily.

As examples of abrasives which have slow but definite solubility in water solutions of the detergent, I may use dicalcium phosphate ($CaHPO_4$), a tricalcic phosphate $Ca_3(PO_4)_2$, calcium carbonate ($CaCO_3$), magnesium oxide (MgO), calcium metaphosphate or magnesium metaphosphate.

As the detergent which in water solution exerts a solubilizing action on the abrasive, I may employ an alkali-metal metaphosphate or tripolyphosphate or mixtures thereof. The preferred alkali-metal metaphosphate is the soluble sodium hexametaphosphate sometimes called "Graham's salt". The sodium hexametaphosphate is assumed to be a complex of the general formula $Na_2(Na_4P_6O_{18})$, although some authorities believe that salts of the formulas $Na_5(NaP_6O_{18})$ and $Na_4(Na_2P_6O_{18})$ may also be present. Sodium hexametaphosphate in readily soluble form may be prepared by strongly heating monosodium dihydrogen orthophosphate and rapidly cooling the molten mass. The quick cooling is apparently essential to the formation of a readily soluble salt. If the monosodium dihydrogen orthophosphate is not heated to fusion, or if the molten mass resulting from strong heating is not cooled with sufficient rapidity, crystalline metaphosphates may be formed which are less readily soluble or even practically insoluble in water. These are less desirable, although even the sodium metaphosphates which are practically insoluble in water alone will dissolve to a limited extent in solutions of mineral acids, as described in Munter application Serial No. 68,442, and likewise in saliva to produce some of the effective sodium hexametaphosphate. Although it is preferred that the metaphosphate used in the detergent composition be formed in such a manner that it consists principally of the water-soluble hexametaphosphate, the invention is intended to include the use of any alkali-metal metaphosphate which contains or yields under the conditions of use sufficient hexametaphosphate to produce the desired effect.

The alkali-metal tripolyphosphates act similarly to the alkali-metal metaphosphates in solubilizing the abrasives by combining with calcium and magnesium to form soluble complexes from which the calcium or magnesium is but extremely slightly ionized. The alkali-metal tripolyphosphates may therefore be used in place of or in combination with the alkali-metal hexametaphosphates. The preferred alkali-metal tripolyphosphate for use in accordance with the present invention is sodium tripolyphosphate.

The alkali-metal tripolyphosphates are chemical compounds of the formula $M_5P_3O_{10}$ in their anhydrous form, in which M represents an alkali-metal. Sodium tripolyphosphate is the most common and important of the alkali-metal tripolyphosphates. Chemical and X-ray analyses show that crystalline sodium tripolyphosphate is a definite chemical compound which is distinct from both sodium hexametapohsphate and sodium pyrophosphate and that it is not a mixture of the two. Sodium tripolyphosphate is fusible and the fused mass may be solidified by very rapidly cooling in a glassy amorphous mass. Under slower cooling, the fused mass solidifies in the form of crystals. The glass may be converted into crystalline tripolyphosphate by annealing. Sodi-

um tripolyphosphate forms a crystalline hydrate of the general formula $Na_5P_3O_{10}.6H_2O$. Sodium tripolyphosphate is colorless, appearing white in the granulated crystalline form. When crushed, it forms a free-flowing granular mass. By suitable precautions it may be produced in a mass which readily disintegrates into its constituent fine crystals. Sodium tripolyphosphate is not deliquescent and particularly in its hydrated form may be preserved indefinitely in ordinary atmospheres without caking or picking up moisture. Sodium tripolyphosphate is readily water-soluble.

The alkali-metal metaphosphates and tripolyphosphates are "molecularly dehydrated phosphates" as such term is employed in Hall and Jackson Patent No. 1,903,041. For example, sodium metaphosphate ($NaPO_3$) may be considered as derived from monosodium dihydrogen orthophosphate by the removal of water of constitution. Likewise, sodium tripolyphosphate may be similarly considered as derived by molecular dehydration of a mixture of orthophosphates which is intermediate in acidity between the monosodium dihydrogen ortho phosphate and the disodium monohydrogen orthophosphate. The metaphosphates and tripolyphosphates may be regarded as salts of condensed or molecularly dehydrated phosphoric acids which have been molecularly dehydrated to a greater extent than pyrophosphoric acid.

The abrasive detergent composition may contain soap or an alkali, or both, in addition to the abrasive and the alkali-metal metaphosphate or tripolyphosphate.

A composition for use as a powder in cleaning the teeth may be as follows:

Example I

	Per cent
Impalpable dicalcium phosphate ($CaHPO_4$)	70
Powdered sodium hexametaphosphate or sodium tripolyphosphate	20
Neutral soap	6
Flavoring and perfume	4

Another dentifrice composition is:

Example II

	Per cent
Insoluble sodium metaphosphate	80
Sodium hexametaphosphate or tripolyphosphate	3
Dicalcium phosphate	5
Neutral soap	8
Flavoring and perfume	4

The composition prepared in dry powdered form is used in the ordinary manner in cleaning teeth by applying the powder to the toothbrush. The composition may be made into a paste by the addition of water.

Suitable compositions for cleaning walls or polishing metallic objects are as follows:

Example III

	Per cent
Soap	50
Tricalcium phosphate (Ca_3PO_4)	40
Sodium hexametaphosphate or tripolyphosphate	10

Example IV

	Per cent
Trisodium phosphate	40
Finely divided calcium carbonate	30
Sodium hexametaphosphate or tripolyphosphate	30

In Example III the soap is preferably a neutral soap. Other alkaline salts may be used in place of the trisodium phosphate of Example IV, for example sodium carbonate, borax, sodium hydroxide, and sodium meta- or other silicate. In cleaning walls and metal objects, the powder may be supplied to a sponge or rag which has been previously moistened and the surface to be cleaned is rubbed.

The alkali-metal hexametaphosphate and tripolyphosphate have a detergent and emulsifying effect on grease which may be present on the surfaces of metal objects or on the coating on walls or other surfaces. The hexametaphosphate and tripolyphosphate also have the property of preventing the precipitation of insoluble calcium and magnesium soaps and salts which otherwise would form when a composition containing soap or alkali is moistened with hard water. The prevention of the formation of insoluble calcium and magnesium soaps enables the soluble soap in the composition to act on the soil without hindrance by the formation of insoluble soaps. The alkali in the composition emulsifies grease and dirt, thereby increasing the efficiency of the soluble soap in the cleaning or polishing process. The scouring action of the abrasive is augmented by the emulsifying effect of the hexametaphosphate or tripolyphosphate on grease.

The composition may be used as a powder, paste or other suitable form. While I prefer to use the sodium hexametaphosphate or tripolyphosphate, or mixtures thereof, other alkali-metal hexametaphosphates or tripolyphosphates may be used, such as the hexametaphosphates or tripolyphosphates of potassium, lithium and ammonium.

Where mixtures of the alkali-metal metaphosphates and tripolyphosphates are employed, such mixtures may be made mechanically, or chemically by using the proper ratio of phosphorus pentoxide to alkali-metal oxide in the starting material.

Although I have given certain preferred compositions by way of illustration only, it is to be understood that the invention may be otherwise embodied within the scope of the following claims.

I claim:

1. An abrasive detergent composition containing an alkali-metal salt of the group consisting of soluble metaphosphate and tripolyphosphate which is capable of sequestering calcium in a but slightly ionized condition, and an inorganic abrasive which is insoluble or only slightly soluble in water but which is soluble in water solutions of said alkali-metal salt.

2. An abrasive detergent composition containing an alkali-metal hexametaphosphate and an inorganic abrasive which is insoluble or only slightly soluble in water but which is soluble in water solutions of said alkali-metal salt.

3. An abrasive detergent composition containing sodium hexametaphosphate and an inorganic abrasive which is insoluble or only slightly soluble in water but which is soluble in water solutions of said alkali-metal salt.

4. An abrasive detergent composition containing an alkali-metal tripolyphosphate and an inorganic abrasive which is insoluble or only slightly soluble in water but which is soluble in water solutions of said alkali-metal salt.

5. An abrasive detergent composition containing an alkali-metal salt of the group consisting of soluble metaphosphate and tripolyphosphate

which is capable of sequestering calcium in a but slightly ionized condition, and an inorganic abrasive of the group consisting of dicalcium phosphate, tricalcic phosphate, calcium carbonate, magnesium oxide, calcium metaphosphate, and magnesium metaphosphate.

6. A dentrifrice containing an alkali-metal salt of the group consisting of soluble metaphosphate and tripolyphosphate which is capable of sequestering calcium in a but slightly ionized condition, and an inorganic abrasive which is insoluble or only slightly soluble in water but which is soluble in water solutions of said alkali-metal salt.

7. A dentifrice containing an alkali-metal hexametaphosphate and an inorganic abrasive which is insoluble or only slightly soluble in water but which is soluble in water solutions of said alkali-metal salt.

8. A dentifrice containing sodium hexametaphosphate and an inorganic abrasive which is insoluble or only slightly soluble in water but which is soluble in water solutions of said alkali-metal salt.

9. A dentifrice containing an alkali-metal tripolyphosphate and an inorganic abrasive which is insoluble or only slightly soluble in water but which is soluble in water solutions of said alkali-metal salt.

10. A dentifrice containing a crystalline alkali-metal metaphosphate which yields alkali-metal hexametaphosphate during use in the mouth, and an inorganic abrasive which is insoluble or only slightly soluble in water but which is soluble in water solutions of alkali-metal hexametaphosphate.

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