

1

3,640,879

CLEANING COMPOSITION AND METHOD OF USING SAME

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12 Claims

ABSTRACT OF THE DISCLOSURE

A cleaning composition especially suited for use in cleaning dental prosthetic devices comprising a mixture of lithium hypochlorite, a member selected from the group consisting of alkali metal pyrosulfate, alkali metal bisulfate and mixtures thereof, an alkali metal hydroxide and, preferably, a surface active agent.

REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of application Ser. No. 791,512, filed Jan. 15, 1969 entitled "Cleaning Composition and Method of Using Same," now abandoned.

BACKGROUND OF THE INVENTION

The present invention relates to a cleaning composition particularly adapted as a dental prostheses cleaner and methods of preparing and using the same. The mixture comprises solid chemicals that are highly useful when dispersed in liquid media for effectively and efficiently removing deposits including, for example, stains from food, tobacco, or other sources; mucin; food particles; tartar and calculus from dental prosthetic devices.

Numerous proposals have been made for producing cleaning agents such as denture cleaners. These agents generally are subject to one or more disadvantages which have militated against their more widespread use and acceptance. Thus, for example, certain of the cleaners which have been proposed contain a relatively high proportion of acids, such as hydrochloric acid, which have a corrosive effect upon metallic portions of dentures and introduce problems of handling and packaging. Such cleaners, as well as others, have required, in their use, the brushing of the dentures in order to reasonably effectively remove the undesired deposits thereon. Certain cleaners have been marketed wherein the denture is simply immersed in a solution of the cleaning composition, removed therefrom, and then rinsed in water. Such latter cleaners, which depend primarily upon relatively high alkalinity to produce a cleaning action, do not function as effectively as may be desired and, in any case, require an undue period of time of immersion of the denture in order to obtain reasonably satisfactory results. Other disadvantages have characterized such known cleansers with which those versed in the art are familiar and which, therefore, require no further elaboration.

Such cleaning agents generally comprise alkaline perborates as the prime oxidizing agents with phosphates, carbonates and silicates as the prime alkaline agents. Further description of denture cleaners can be found in "The Nature and Behavior of Denture Cleaners," Anthony et al., J. Pros. Den., September-October 1958, pages 796-811. Various proposals for denture cleaners can be found in the patent literature such as U.S. Pat. Nos. 2,498,344; 3,114,111; 3,337,466 and 3,372,125.

2

SUMMARY OF THE INVENTION

It has been found that the combination of lithium hypochlorite, a member selected from the group consisting of alkali metal pyrosulfate, alkali metal bisulfate and mixtures thereof, preferably potassium pyrosulfate and an alkali metal hydroxide, preferably lithium hydroxide, advantageously in the presence of a surface-active agent, when dissolved in an aqueous medium possesses an outstanding ability to effectively clean such materials as porcelain, phenolformaldehyde, melamine formaldehyde, cellulose acetate, vinyls, acrylic, polycarbonates, silicone polymers, styrene, rubber (natural or synthetic), metals such as gold and silver and metal alloys such as alloys of chromium, cobalt, nickel and the like without adverse effect on these materials. The various metallic, ceramic and plastic surfaces are, as a consequence of the cleaning process, restored to a lustrous clean condition after simple rinsing in water. No film, odor or taste is left on the material as a result of the cleaning.

The cleaning composition according to the invention comprises a mixture of lithium hypochlorite and a member selected from the group consisting of alkali metal pyrosulfate, alkali metal bisulfate or mixtures thereof, preferably, potassium pyrosulfate in a weight ratio which may vary from about 1:3.5 to 3.5:1 and preferably in equal amounts by weight (equivalent to about 4 moles of lithium hypochlorite per mole of pyrosulfate, bisulfate or mixtures thereof). Sufficient alkali metal hydroxide hereafter illustrated as lithium hydroxide is added to produce a pH of the dissolved composition in excess of 8, generally from 9 to 14 and preferably from 10 to 12. An alkaline stable surface-active agent is preferably present in an amount of from about 1 to 25 weight percent based on total dry composition. The resulting composition in its preferred form is stable, substantially dry, odorless, free flowing and nonlumping. In particulate or finely divided form, preferably predominantly granular, the composition can be easily packaged and stored for a considerable period of time without deterioration. When dissolved in an aqueous medium, the cleaning solution remains active for a considerable period of time. The composition may also be prepared in the form of a tablet, pill, pellet, bead or the like.

When ready for use, the composition can be quickly diluted with water to provide a clear, noncloudy solution without the tendency to form a scum. The exact amount of dry cleaning composition added to the water depends in the last analysis on the degree of contamination of the material to be cleaned and the time in which cleaning is desired. An amount of 2 to 15 grams per 100 milliliters of water has been found particularly effective.

DETAILED DESCRIPTION OF THE INVENTION

The term "dental prosthetic device" or "dental prostheses" as used in the following description and in the appended claims includes such devices as artificial teeth, removable orthodontic bridges and denture plates of both upper and lower types, full or partial. Such dental prosthetic devices have a tendency to become stained by foods and by the nicotine and tars derived from smoking tobacco. Many are of such irregular configuration that food particles tend to cling to the denture. Further, if they are not cleaned properly, germs and slime may develop thereon giving rise to unpleasant odors. The present process and composition provides means for cleaning and deodorizing dental prosthetic devices. The term "cleaning"

as used herein is intended to include all the actions of cleaning, deodorizing and removal of residual food particles.

While the cleaning compositions of the present invention find particular utility in the cleaning of dental prosthetic devices, it also effectively cleans other objects such as pipe stems, cigarette holders, earpieces of hearing aids, silverware, jewelry, dishware, and other articles of plastic, ceramic and metal. Its cleaning power includes tarnish, food, tartar, calculus, tar, smoking stains, coffee stains, tea stains, etc.

To the base composition other ingredients may be added such as chelating agents, dyes, free-flowing agents, flavors, indicators, surface-active agents, masking agents, perfumes, fragrances and others, as for example, bonding agents should the mixture be processed in shaped form such as a tablet, to more suitably adapt the invention to a specific use. Such agents are illustrated, for example, in the above-mentioned patents which are incorporated herein by reference.

Thus, the surface active agent aids in producing a sparkling, clean article after treatment. As the surfactant is not appreciably consumed or altered in the cleaning process, it need be present in only small concentration to be effective. Since it confers on the solution a sudsy appearance and pleasant "feel" to the immersed hand of the user (momentary, to remove the article from the bath), it is preferred that it be present in appreciable amount. Conveniently, and from empirical findings, an amount of surface active agent (by weight in grams) up to an equivalent to the amount of lithium hypochlorite may be used.

In the case of dental prosthetic devices, the extent or combination of deposits from use does not appear to alter the efficaciousness of the mixture. Materials imbedded in pores and crevices of the devices are removed. Aqueous solutions have been extensively examined and denture cleaner users are already conditioned to "soaking" their denture appliances. As short a period as 5-20 minutes is required for most denture cleanings and this interval varies with individual denture contamination type and extent. Alternatively, "overnight" soaking has proven to be a convenient period, especially in difficult cases, and this period leads to no adverse effects to the dental prosthetic device or to associated materials, such as metal clasps. Indeed, the device may be left in contact with the cleaning solution for several days (e.g. seven days) with no adverse effects. With such extended time periods, however, especially with the more potent mixtures, a faint, chlorine-like odor may develop as the reagent becomes spent. For general application, it is recommended that a time period of from 5 minutes to 24 hours be employed for full cleaning.

The question of a device requiring a second application of the cleaner according to the invention at the time of the initial cleaning is a moot one, since substantially all dentures encountered in "live" testing were rendered completely clean and lustrous by a single application. It is possible, although not likely, that in use, there would be encountered a case so contaminated as to expend the active ingredients before complete cleaning was achieved. In such a case, a follow-up treatment would be recommended. Once initial contact with the claimed denture cleaner has rendered the device clean, periodic retreatment based on the individual case, permits the user to maintain his denture in clean condition at all times.

The basic cleaning composition according to the present invention comprises a member selected from the group consisting of alkali metal pyrosulfate, alkali metal bisulfate and mixtures thereof—preferably, and hereafter illustrated as potassium pyrosulfate, lithium hypochlorite and alkali metal hydroxide—preferably and hereafter illustrated as lithium hydroxide. Typical dry formulations according to the invention have a weight amount as follows:

Ingredient	Percent by weight	
	Broad	Preferred
Lithium hypochlorite (LiOCl).....	20 to 65....	30 to 55.
Potassium pyrosulfate (K ₂ S ₂ O ₇).....	20 to 65....	30 to 55.
Lithium hydroxide (LiOH).....	3.5 to 25....	7 to 20.

To this basic composition is preferably added from about 1 to 25, preferably 2 to 15 percent by weight of a surface-active agent.

In addition to this basic reagent formulation where prolonged solution stability is required or desired, lithium chloride may be added. It functions by a common-ion effect to retard the very slow decomposition of the lithium hypochlorite to lithium chloride. As an equilibrium shifter (to the side of the desired ingredient), its function is one of a preservative, or stabilizer. As such, it is a desired component. In normal use, the dry reagent formulation possesses adequate stability. The concentration of lithium chloride that has been used successfully has been as high as one molar equivalent (to the hypochlorite).

In lieu of all or part of the lithium hydroxide there may be employed a different alkali metal hydroxide (e.g. sodium and potassium). The lithium salt is preferred to maintain integrity of the system although the other alkali metal hydroxides may be employed.

As stated above, one ingredient of the cleaning composition according to the invention is a member selected from the group consisting of alkali metal pyrosulfate, alkali metal bisulfate or mixtures thereof. It has been found that potassium pyrosulfate, K₂S₂O₇, is superior to the other alternatives particularly in terms of cleaning efficiency, availability and storage stability. Potassium pyrosulfate is also known as fused potassium bisulfate or "anhydrous" potassium acid sulfate and can be obtained by heating potassium bisulfate. It is soluble in water and is believed to be slowly converted to potassium bisulfate in the alkaline solution formed by adding water to the dry composition according to this invention.

Sodium and/or lithium pyrosulfate may also be employed in lieu of all or part of the potassium pyrosulfate if desired. Additionally, some of all of the pyrosulfate may be deleted and replaced by an equal amount of alkali metal bisulfate, for example, sodium, lithium, potassium or mixtures thereof. However, where prolonged storage stability is desired, it is not recommended that the bisulfates be used particularly where care is not taken in packaging. The bisulfates such as potassium are deliquescent and the sodium form is stated to be unstable in air. As such, particular care must be taken in packaging, a feature considered detrimental from a commercial standpoint. If not carefully packaged, the composition containing the bisulfate may pick up water from the air causing premature reaction and consequent reduction of cleaning efficiency.

The ingredients in the composition according to the invention are generally commercially available inorganic chemicals most of which are easily available. The chemicals may be used in their anhydrous or hydrated form and may be employed in their standard technical, analytical or reagent grades and purity.

When employing the surface-active agent and lithium chloride in the composition according to the invention, the weight amounts on a dry basis may vary as follows:

Ingredient	Percent by weight	
	Broad	Preferred
Lithium hypochlorite (LiOCl).....	10 to 55....	20 to 45.
Potassium pyrosulfate (K ₂ S ₂ O ₇).....	10 to 55....	20 to 45.
Lithium hydroxide (LiOH).....	4 to 23....	7 to 20.
Surface active agent.....	1 to 25....	2 to 15.
Lithium chloride (LiCl).....	1 to 35....	5 to 20.

The following examples serve to further illustrate the nature of the invention and are not intended to impliedly or expressly restrict the nature thereof.

5
EXAMPLE 1

A mixture consisting of 5.0 grams of potassium pyrosulfate, 5.0 grams of lithium hypochlorite, 2.0 grams of lithium hydroxide, and 1.0 gram of Duponol C (E. I. du Pont de Nemours' brand of sodium lauryl sulfate) was prepared by grinding the ingredients separately to remove lumps or large particles and mixing the resulting dry powders. The resulting mixture was a white, a free-flowing powder and was packaged in various dosages for further use.

An 8.0 gram quantity of the mixture described above was dissolved in 100 milliliters of hot water (approximately 140° F. tap water). With slight swirling of the mixture, solution was rapid and complete, giving a pH of 11. A soiled denture (complete upper or lower plate) was immersed in the solution for 15 minutes. Upon removal and rinsing with water, all tar and nicotine, stains had been removed together with the calculus, food debris, and other solid materials. The porcelain, acrylic, and metal portions of the denture were bright and shining and resembled those of a freshly manufactured, unused denture.

In additional experiments, the above-stated amount of potassium pyrosulfate was replaced by equal amounts of sodium and potassium bisulfate. In each instance, the resulting composition performed in essentially the same manner when a freshly mixed composition was employed. Extended stability tests, however, where the bisulfate-containing compositions were packaged in plain paper, showed a reduction in cleaning efficiency and a noticeable bleaching of the packaging paper indicating a pickup of water from the air and premature reaction.

In other experiments, sodium and potassium bisulfate were used to partially replace the stated amount of potassium pyrosulfate in the above composition. The replacement in each case was on a 25, 50 and 75 percent basis (weight). The results were essentially as stated above with storage stability increasing as the amount of bisulfate decreased.

A substitution of sodium or lithium pyrosulfate for potassium pyrosulfate as stated above produces a composition of the same essential cleaning efficiency and characteristics.

EXAMPLE 2

A mixture is prepared by grinding together with a mortar and pestle 5.0 grams potassium pyrosulfate, 3.0 grams lithium hypochlorite, 2.0 grams lithium chloride, 2.0 grams lithium hydroxide and 1.0 grams sodium lauryl sulfate. The article to be cleaned, in this case a denture, is covered with about 100 ml. of hot tap water (70° C.). To this is added 10 grams of the above mixture with sufficient agitation to promote dissolution.

Soaking is accomplished for 30 minutes and the denture is then removed, rinsed with warm water and dried. The denture is restored to a clean, lustrous, tasteless condition.

EXAMPLES 3-9

In a manner similar to Example 1 the following dry formulations are prepared:

Example	Percent by weight						
	3	4	5	6	7	8	9
Ingredients:							
Potassium pyrosulfate	40	45	42	30	38	25	30
Lithium hypochlorite	40	35	33	44	25	55	20
Lithium chloride				15		5	20
Lithium hydroxide	14	7	17		25	19	20
Surface active agent	*6	*6	*8	**2	**12	*5	*10
Sodium hydroxide		7		9			

*Sodium lauryl sulfate.

**Sodium dodecyl benzene sulfonate.

When the above compositions are dissolved in 100 ml. of water in an amount ranging from 1 to 15 grams per

6

100 ml., they effectively clean a variety of dentures in a short period of time without adverse effect on the denture material.

EXAMPLE 10

A mixture consisting of 4.0 grams of potassium pyrosulfate, 5.5 grams of lithium hypochlorite, 2 grams of lithium hydroxide and 2 grams of sodium lauryl sulfate is ground together and the resulting dry composition is added in an amount of 5 grams to 100 milliliters of tap water (room temperature).

Various articles such as small gold jewelry pieces, a hearing aid ear piece and a denture when immersed in the resulting solution are cleaned and restored to a bright and shining appearance after from 25 to 60 minutes of soaking.

I claim:

1. A cleaning composition for dilution in an aqueous medium consisting essentially of lithium hypochlorite, a sulfate selected from the group consisting of alkali metal pyrosulfate, alkali metal bisulfate and mixtures thereof and an alkali metal hydroxide, the lithium hypochlorite and sulfate being present in a weight ratio between about 1:3.5 to 3.5:1 and the amount of alkali metal hydroxide being sufficient to impart a pH in excess of 8 to a solution of said ingredients in water in an amount of 2 to 15 grams per 100 milliliters.

2. The cleaning composition according to claim 1 wherein the sulfate is an alkali metal pyrosulfate.

3. The cleaning composition according to claim 2 having the following ingredients in the following percents by weight:

Ingredient:	Percent by weight
Lithium hypochlorite	20 to 65
Sulfate	20 to 65
Alkali metal hydroxide	3.5 to 25

4. The cleaning composition according to claim 2 wherein the ingredients are present in the following percents by weight:

Ingredient:	Percent by weight
Lithium hypochlorite	30 to 55
Sulfate	30 to 55
Alkali metal hydroxide	7 to 20

5. The composition according to claim 2 wherein the alkali metal hydroxide is lithium hydroxide.

6. The composition according to claim 2 wherein the sulfate is potassium pyrosulfate.

7. A liquid cleaning solution consisting essentially of the composition according to claim 2 dissolved in an aqueous medium in an amount corresponding to about 2 to 15 grams per 100 milliliters.

8. The cleaning composition according to claim 6 containing from 1 to 25 percent by weight of a solid alkaline stable anionic surface active agent.

9. The cleaning composition according to claim 6 wherein the lithium hypochlorite and potassium pyrosulfate are present in about an equal percent by weight and the amount of alkali metal hydroxide is sufficient to impart a pH to a solution of said ingredients in water in an amount of 2 to 15 grams per 100 milliliters of from 9 to 14.

10. The cleaning composition according to claim 8 containing the following ingredients in the following percents by weight:

Ingredient:	Percent by weight
Lithium hypochlorite	10 to 55
Potassium pyrosulfate	10 to 55
Lithium hydroxide	4 to 23
Surface active agent	1 to 25
Lithium chloride	1 to 35

7

11. The cleaning composition according to claim 10 containing the following ingredients in the following percents by weight:

Ingredient:	Percent by weight	
Lithium hypochlorite	20 to 45	5
Potassium pyrosulfate	20 to 45	
Lithium hydroxide	7 to 20	
Surface active agent	2 to 15	
Lithium chloride	5 to 20	

12. A method of claning dental prosthetic devices comprising contacting said devices with a cleaning composition according to claim 2 and then rinsing the device to remove cleaning ingredients therefrom.

8

References Cited

UNITED STATES PATENTS

2,498,344	2/1950	Rider et al.	252—103
3,113,111	12/1963	Myerson	252—99
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MAYER WEINBLATT, Primary Examiner

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10 252—96, 99, 100, 187; 424—149