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FLUORINATED TOOTHBRUSH BRISTLE AND METHOD OF MAKING SAME

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This invention relates to toothbrush bristles and more particularly to toothbrush bristles which contain a fluoride.

It is recognized that the incidence of dental caries may be reduced through the use of fluorides. This had led to the incorporation of fluorides in drinking water and toothpastes and also to the application of fluorides to the teeth by dentists.

It would appear desirable, therefore, to incorporate fluorides into toothbrush bristles since the bristles are applied directly to the teeth when the toothbrush is used. Such a brush would not only serve as an adjunct to dental prophylaxis involving the use of fluorides, but would be especially useful when other ways of applying fluorides to the teeth are not readily available.

Most toothbrush bristles are made from synthetic thermoplastic materials; nylon, in particular, has been so used extensively. These materials, because of their thermoplastic properties, can be readily extruded into filaments from which the bristles are formed. This has led to the incorporation of fluorides into toothbrush bristles by mixing the salt of a fluoride, e.g. calcium fluoride, with granules of the synthetic thermoplastic material and then melting and extruding the thermoplastic material into filaments containing the fluoride salt from which the bristles are made. This may be referred to as a "hot melt" method. However, since nylon and similar thermoplastic materials are relatively non-porous, the fluoride in the interior of the filament is not readily leached out when a toothbrush having bristles containing a fluoride so incorporated is used.

Further, in forming filaments from such synthetic thermoplastic materials it is necessary to heat the material sufficiently to melt it before it can be extruded. Since the temperatures involved are relatively high, e.g. of the order of 300° C. for nylon, and since fluorides are generally quite reactive chemically, the particular fluorides to be incorporated must have heat stability and must also be otherwise unaffected when subjected to such temperatures. It is also necessary that the particular fluoride used does not react or become bound with the nylon or other materials so that it will be extractable upon use.

The foregoing problems attendant with incorporating fluorides into synthetic thermoplastic materials by the so-called "hot melt" method suggest the desirability of incorporating fluorides by other methods in which the temperature and other conditions of processing are not so extreme. Although nylon and similar synthetic thermoplastic materials are considered relatively non-porous, they are capable of absorbing a certain amount of moisture; the amount absorbed is enhanced at elevated temperatures. It was thereupon concluded that a fluoride may be incorporated into bristles formed of such thermoplastic materials by soaking the bristles in an aqueous solution of a fluoride salt. It was determined that a measurable amount of fluoride can be so incorporated into the bristles, particularly at relatively high concentrations of the fluoride and at elevated temperatures, such as a 40% aqueous solution of stannous fluoride at 100° C. Such concentrations and temperatures require somewhat specialized apparatus and caution in handling and processing the bristles due to the nature of the fluoride salt.

In addition, another problem was noted: In processing bristles, it is desirable as a practical matter to process

a bundle of bristles or hank of filaments from which the bristles are formed, rather than individual bristles. After drying a bundle of bristles which had been immersed in an aqueous solution of stannous fluoride and then rinsed, a removable powdery deposit was noted on the bundle, particularly at the ends. It was concluded that fluoride salt had migrated to the surface of the bundle. Efforts to solve this problem led to the surprising discovery that the formation of the powder could be eliminated by including a humectant, such as glycerine, into the fluoride solution. In view of the water solubility of such humectants as glycerine, it might be concluded that the humectant would be removed during rinsing after imersing the bristles in the aqueous fluoride solution and that the powder would still form on the surface of the bristles. Since the powder did not form, it was concluded that the glycerine penetrated the bristles and in so doing assisted the fluoride in penetrating the bristle also.

The desirability of incorporating a fluoride into bristles by an impregnation or soaking process instead of by the "hot melt" process is further emphasized by the fact that, in use, the bristle is subjected to a similar process, that is, since the fluoride is incorporated into a bristle by a soaking operation, the fluoride will be extractable from the bristle in a more or less reversible sense when it is subjected to another soaking operation, as when a toothbrush having such bristles is used.

It is therefore an object of this invention to provide a toothbrush having bristles containing a fluoride which is extractable from the bristle when the brush is used. It is another object of this invention to provide a method for incorporating fluoride into toothbrush bristles which is economical, practical and which minimizes the difficulties usually present in handling fluorides. In its more specific aspects, the invention concerns a toothbrush bristle of synthetic thermoplastic material which is impregnated with a fluoride by immersing the bristles, or the bristle stock from which the bristles are made, in a solution containing a water soluble fluoride salt and a humectant.

By way of example, the following is the preferred method of carrying out the invention. The apparatus used should desirably be polyethylene or polyethylene lined.

10 grams of stannous fluoride and 10 grams of glycerine are dissolved in approximately 100 ml. of water by adding the fluoride and then the glycerine slowly with constant stirring and the solution brought to a temperature of about 20° C. to about 25° C.

Into the solution so prepared there is placed fifty grams of nylon filaments, pre-cut to a length of two inches and bound in the form of a bundle, the filaments having a diameter of from about 0.008 to about 0.013 inch. The bundle of filaments is retained completely immersed in the solution for about one hour with occasional agitation. The bundle is then removed from the solution, rinsed twice with one liter portions of water, drained and then dried. The filaments do not contain any powderous deposit on their surface and have the appearance of untreated bristles. The filaments may then be fed into a standard bristling machine for bristling toothbrushes.

The foregoing method of incorporating a fluoride into bristles involves the use of relatively low fluoride concentrations and relatively low temperatures, and hence does not require the use of highly specialized and expensive equipment or complicated precautionary measures.

The time of immersion and the temperature of the fluoride solution within which the bristles are immersed may be suitably modified. The amount of fluoride incorporated into the bristle may be increased, for a given period of time of immersion, by increasing the

concentration of the fluoride in the solution. Also, increasing the temperature of the solution will increase the amount of fluoride impregnated. By way of example, by immersing the bristles in a 10% solution of stannous fluoride at 25° C. for about one hour, about 0.25% of stannous fluoride by weight will be incorporated into the bristles. By increasing the time of immersion to 18 hours, the amount of stannous fluoride incorporated will be about 0.75%. If the temperature of the solution is increased to 100° C. and the time of immersion maintained at one hour, about 0.5% of stannous fluoride by weight will be incorporated. The concentration of the fluoride may range from about 10 to about 40 percent, the time of immersion from about one hour upwardly, (shorter immersion times give correspondingly less fluoride impregnated) and the temperature of the solution from about 10° C. to about 100° C. The particular fluoride concentration, immersion time and solution temperature selected will be governed by the economics involved, and by the practical considerations of handling and the equipment required. As noted above, the preferred concentration of the fluoride salt is about 10%, the time about one hour and temperature from about 20° C. to about 25° C.

Any synthetic plastic material suitable for use in making toothbrush bristles may be impregnated with the fluoride, including cellulose acetate, cellulost nitrate, vinylidene chloride, and other polymers, mixed polymers, and interpolymers. The prefered synthetic plastic material is nylon.

Since the method involves the use of aqueous solutions containing fluorides, and since it is desired that the fluoride be extracted during brushing, the fluoride should be at least partially soluble in water or extractable when used in conjunction with tooth cleaning preparations, such as toothpaste. Stannous fluoride is preferred since it is soluble in water and readily impregnates the bristle. Other water soluble salts of fluorides, including other polyvalent salts and water soluble organic compounds containing fluoride, such as phenyl stannous fluoride and benzalkonium fluoride, may be used providing the type selected and the amount incorporated in the bristle is consistent with the conditions of intended use. Those fluorides which are highly soluble in water impregnate the bristle more readily and are more readily leached out from the bristle when a brush having such bristles is used. Conversely, a less soluble fluoride may be used where bristles having a longer lasting effect is desired.

While glycerine, because it is well known and relatively inexpensive, is preferred as a humectant, other humectants, such as other water soluble polyhydric alcohols, acceptable from the viewpoint of intended use, including propylene glycol and polyethylene glycol, may also be used. The amounts of the humectant incorporated into the aqueous fluoride solution may be varied. About 10% by weight has been found particularly satisfactory and is thus preferred.

It is apparent that numerous variations, modifications, and changes may be made in the above-described illustrative example while still remaining within the spirit of the invention.

What is claimed is:

1. A toothbrush bristle of synthetic organic plastic material impregnated with a water soluble salt of a fluoride and a water-soluble polyhydric alcohol humectant.

2. A toothbrush bristle of synthetic organic plastic material impregnated with a water soluble salt of a fluoride and a water soluble polyhydric alcohol humectant.

3. A toothbrush bristle of synthetic organic plastic material impregnated with stannous fluoride and glycerine.

4. A toothbrush bristle of nylon impregnated with a water soluble salt of a fluoride and a water-soluble polyhydric alcohol humectant.

5. A toothbrush bristle of nylon impregnated with stannous fluoride and glycerine.

6. The method of incorporating a fluoride into a filament of synthetic organic plastic material suitable for use as a toothbrush bristle which comprises treating said filament with an aqueous solution of a water soluble salt of a fluoride and a water-soluble polyhydric alcohol humectant at a temperature range of from about 5° C. to about 100° C. until said material has been impregnated with said fluoride.

7. The method of incorporating a fluoride into a filament of synthetic organic plastic material suitable for use as a toothbrush bristle which comprises treating a bundle of said filaments with an aqueous solution of a water soluble salt of a fluoride and a water-soluble polyhydric alcohol humectant at a temperature range of from about 5° C. to about 100° C. until said material has been impregnated with said fluoride.

8. The method of incorporating a fluoride into a filament of synthetic organic plastic material suitable for use as a toothbrush bristle which comprises treating said filament with an aqueous solution of a water soluble salt of a fluoride and a water soluble polyhydric alcohol humectant at a temperature range of from about 5° C. to about 100° C. until said material has been impregnated with said fluoride.

9. The method of incorporating a fluoride into a filament of synthetic organic plastic material suitable for use as a toothbrush bristle which comprises treating said filament with an aqueous solution containing at least about 10% by weight of stannous fluoride and about 10% by weight of glycerine for about one hour at a temperature range of from about 5° C. to about 100° C. until said material has been impregnated with said fluoride.

10. The method of incorporating a fluoride into a filament of nylon suitable for use as a tooth-brush bristle which comprises treating said nylon filament with an aqueous solution containing at least about 10% by weight of stannous fluoride and about 10% by weight of glycerine for about one hour at a temperature range of from about 20° C. to about 25° C. until said material has been impregnated with said fluoride.

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