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DENTAL CEMENT COMPOSITION

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This invention relates to dental cements for filling cavities in teeth and more particularly to dental cements of the silicate and metal oxide type employing phosphoric acid as binding liquid and a method of making the same.

It is known that pretreated silicates, for instance, aluminum silicates, or certain metal oxides, for instance, zinc oxide, have the property on mixing with phosphoric acid so as to form a plastic paste, to set in a short time to a solid hard mass. Upon this reaction there is based the manufacture of dental cements, and various suggestions and patents have for their objects the selection of a proper relation between both components, i. e. between the cement powder and the binding liquid, the phosphoric acid. This relation has been adhered to quite strongly in literature as well as in practical use. It has, however, a number of essential disadvantages of which there may be mentioned the following: In physico-chemical respect the properties of the set cement depend to a great extent upon the optimal proportion between the cement powder and the phosphoric acid, i. e. in practice upon the accidental manner of mixing more or less of the cement powder with the acid. On the other hand as is shown by a great number of publications, in biological respect it is not without danger that it is necessary to fill cavities of teeth with a paste containing free phosphoric acid, on account of the possible irritation of the live pulpa.

Now, these and other disadvantages are avoided according to the present invention. For this purpose the cement powder is modified so as to set with water or an indifferent aqueous solution instead of with phosphoric acid. In accordance with the invention this is achieved by adding to and intimately mixing with the cement powder, for instance, with a suitable aluminum silicate, a salt of a phosphoric acid of high solubility in water which is capable of passing rapidly into solution, in solid finely pulverised state, preferably an acid or primary salt of the acid containing water of crystallisation. On mixing a cement composition of this kind with water there is formed a plastic paste in the same manner as when mixing phosphoric acid with an ordinary cement powder. Said paste sets and hardens to a product exhibiting very remarkable resistance in chemical and physical respect. The chemical advance achieved thereby consists, as is apparent, in the fact that the setting does not take place in a strongly acid medium as before but in a practically neutral one although the speed of setting and hardening is practically the same.

As especially suitable addition to an ordinary cement powder there have proved to be the non-hydroscopic, very readily water soluble hydrated forms of primary salts of phosphoric acid, especially those of lithium, beryllium, aluminum, zinc and magnesium whereby these metal phosphates may be used either alone or in mixture with each other.

A further advantage of a cement composition of this kind consists in the fact that it is possible to vary and adjust the time and speed of setting in great intervals, for instance, from 1 to 10 minutes, depending upon the amount of phosphate added to the cement powder. Thereby the speed of setting decreases with an increase of this addition. In general it is advisable to add about 15 to 30% of phosphate to the cement powder depending upon the nature of the originally used cement and upon the speed of setting desired.

Of course, as it is understood by the expert in this field, the optimal composition is to be found out by preliminary experiments with various salts as well as with various amounts of the salt or salt mixture best suited for this purpose. A cement powder that ordinarily sets in a comparatively long time, is preferable mixed with a salt that is capable of accelerating the setting time, for instance, aluminum mono phosphate while for a cement powder which ordinarily sets rapidly there is used a salt capable of retarding the setting, for instance, zinc mono phosphate. The suitability of other salts may be found out in the same manner.

Instead of the preferably used primary salts of ortho phosphoric acid there may be employed likewise analogous salts and meta- or pyrophosphoric acid. The use of secondary phosphates is advisable only when they possess a sufficient water solubility. Tertiary phosphates are ordinarily excluded for this purpose.

The inventive idea set forth herein and in the claims annexed hereto does not refer—as is stated herewith explicitly—to the use of a binding liquid consisting of phosphoric acid that has been neutralized by means of basic oxides and, hence, contains, besides primary phosphates in solution, free phosphoric acid.

The following examples serve to illustrate the invention, without, however, limiting the same to them:

1. 100 grams of an ordinary dental cement powder, for instance, a sodium aluminum silicate

capable of setting or mixing with phosphoric acid, are intimately mixed with 15 grams of finely pulverized primary zinc phosphate

$$[ZnH_4(PO_4)_2.H_2O]$$

The mixture is capable of forming a plastic paste with water, said paste setting to a very resistant filling.

2. In order to retard the speed of setting of a cement powder as it is used in Example 1 there are added to 100 grams of the same 20 grams of finely pulverized primary zinc phosphate and 20 grams of finely pulverized primary magnesium phosphate. This cement composition sets comparatively more slowly than the cement composition according to Example 1.

3. To produce a more rapidly setting cement composition 100 grams of a cement powder as it is used in Example 1 are mixed with 25 grams of finely pulverized primary magnesium phosphate.

4. 100 grams of zinc oxide as it is used in dentistry are mixed with 20 grams of finely pulverised primary zinc phosphate and 15 grams of primary aluminum phosphate $[AlH_6(PO_4)_3]$. This cement composition sets on mixing with water to a hard and resistant filling.

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