DENTAL AMALGAMS

This invention relates to new dental amalgam compositions and to their preparation. More specifically, it relates to a uniform admixture of specified proportions of two powdered alloys of specific composition which when amalgamated with mercury exhibit enhanced corrosion resistance.

BACKGROUND

Dental amalgams are produced by intimately combining mercury with dental amalgam alloys, conventional of which are comprised generally of from about 67–72% by weight of silver, 25–27% tin, 0–5% copper and 0–2% zinc. Upon reaction with mercury using known dental clinical techniques, a plastic mass is produced which quickly sets into a hard rigid body. While the mass is plastic, it may be packed into a surgically prepared tooth restoring its anatomy and function.

The products of the amalgamation reaction are believed to be a silver-mercury reaction product (Ag_2Hg_3) and a tin-mercury reaction product ($Sn_{7-8}Hg$), referred to in the art as gamma-1 and gamma-2, respectively. It has been recognized that the presence of gamma-2in dental amalgams is a source of corrosion in a saline environment. It is believed that the corrosion process probably releases mercury as a reaction product, resulting in the undesired formation of additional voids and porosities. These may extend well below the surface since the gamma-2 phase in dental amalgam is interconnected. The excess mercury, voids and porosities serve to weaken the dental amalgam especially at the margins which are the interfaces between the restoration and tooth. As a consequence of normal occlusion, stresses generated at a weakened margin may destroy its integrity, allowing leakage of oral fluids and bacteria, thereby promoting secondary decay.

Regardless of whether the aforementioned explanation of the corrosion process due to the presence of gamma-2 is correct (and the present invention is not necessarily limited thereto), it has been found that corrosion can be reduced by techniques which minimize, inhibit or eliminate gamma-2 from dental amalgam compositions. U.S. Pat. No. 3,305,356, for example, discloses the preparation of dental amalgams by mechanically dispersing a hard, strong metal alloy comprising copper and silver throughout a conventional amalgam in the form of very fine particles. There is evidence that in such compositions some of the copper from the dispersed silvercopper alloy combines with tin, thereby inhibiting gamma-2 formation. This is not effective immediately, however, since the copper must first diffuse through a reaction zone which forms around the dispersant. From a corrosion standpoint the gamma-2 is eliminated over a period of weeks after initial trituration and condensation.

Inhibition of gamma-2 has also been attempted by use of silver-tin alloys containing about 5% gold. While the formation of gamma-2 may be somewhat inhibited in such alloys, the resulting gold-tin phase that forms is also subject to saline corrosion. Moreover, the amount of gold required to eliminate gamma-2 completely makes such dental amalgams expensive.

Similarly, for a number of years some dentists have been adding empirical amounts of copper-mercury (copper amalgam) to already triturated conventional amalgam. This procedure produces a good clinical amalgam the structure of which appears to contain little or no gamma-2 phase immediately after trituration. The disadvantage of this technique is that the copper amalgam is heated until mercury beads at its surface prior to mixing. This presents a substantial mercury hazard to the dental personnel and perhaps to the patient.

Other approaches, which may employ high copper content compositions, are disclosed, for example, in U.S. Pat. Nos. 2,281,991 and 3,871,876. In the former a mixture of two comminuted alloys are employed, one, however, being a preformed hardened silver amalgam rich in silver and mercury, which requires special handling procedures. In the latter, advantageous results are reported for an amalgamable silver alloy powder, wherein the particles are generally spheroidal and each particle has a gradient composition from exterior to interior, a characteristic requiring special manufacturing techniques.

Still other approaches have met with some success in minimizing or eliminating the gamma-2 phase, but with undesired side effects. For example, some otherwise successful compositions require increased amounts of mercury for amalgamation of the alloy.

OBJECTS OF THE INVENTION

It is a general object of this invention to provide dental amalgam compositions which cope with the aforementioned problems of other amalgams.

It is a specific object to provide high-copper-content dental amalgamable compositions which are substantially free of mercury prior to amalgamation and which can be readily amalgamated without undue risks to personnel resulting from excessive mercury exposure.

It is another specific object to provide new dental amalgam compositions which upon amalgamation with mercury do not unduly form the gamma-2 phase and which provide enhanced electrochemical properties.

It is another specific object to provide dental amalgam compositions which upon amalgamation with mercury substantially immediately inhibit gamma-2 formation so as to be substantially free of the gamma-2 phase and yet are competitive in cost with other amalgam compositions.

It is another specific object to provide an amalgamable dental composition which can be prepared or manufactured employing conventional techniques.

It is another specific object to provide dental amalgam compositions having improved properties upon amalgamation without unduly increasing the amounts of mercury required in the preparation thereof.

These and other objects will become apparent as the detailed description proceeds.

DESCRIPTION OF THE INVENTION

The new and improved dental amalgam compositions of this invention comprise an admixture of two alloys, hereinafter referred to as Alloy No. 1 and Alloy No. 2, respectively, in comminuted or powdered form, the proportions of the two alloys being somewhat critical for optimum results. Alloy No. 1 as employed in this invention is comprised of silver, tin and copper with silver present in the range of about 40 to 70% by weight, tin in the range of about 10 to 30% by weight and copper in the range of about 20 to 40% by weight. Alloy No. 2 used in accordance with the invention is comprised of silver tin, copper and zinc with silver present in the range of about 55 to 70% by weight, tin in the range of about 20 to 40% by weight, copper in