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METHODS OF PRODUCING METALLIC COMPOSITIONS COMPRISING AMALGAMS

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The invention relates to methods of producing metallic compositions comprising amalgams and especially to such compositions suitable for use in the precision casting of intricate objects.

More particularly an object of this invention is to provide a means of producing metallic compositions which can be moulded to complex metal shapes with a minimum expenditure on tooling and process plant. The most common way of producing such shapes is by casting, in which field there has been considerable development in the art of precision casting. The development of new materials such as plastics, and processes such as powder metallurgy, has provided a greater degree of flexibility in manufacture. However, these processes suffer from a number of disadvantages from the manufacturing or technical points of view; for example, components produced by powder metallurgy require hard metal moulds and result in a product which is weak in tension. There has been a need for a process which is as simple to operate as cast resins, but which results in a product more comparable to a metal casting. This invention is directed towards this end.

Amalgams have been used for a considerable number of years by the dental profession and in more recent years proposals have been made for the production of copper amalgam by mechanically compounding copper particles with mercury, the copper being taken into solution in the mercury. To produce such a compound in bulk by these methods is a difficult operation, and it is an object of the invention to provide a method of producing, in bulk, metallic compounds including amalgams between various metals and mercury suitable for precision casting.

According to the present invention in the production of a metallic composition of a powdered metal with mercury, the powdered metal, before mixing with the mercury, is plated with an intermediary metal which readily amalgamates with mercury and which is present only in small proportions so as to have little or no effect on the properties of the final compound. Such intermediary metal is a metal other than copper. The plating of the intermediary metal is applied without external means for producing electric potentials such as are known in electroplating and may be done in aqueous solution.

The plating is preferably applied by treatment with a solution consisting of, or containing, a salt of the further metal, such solution having the property of removing, without eroding the metal, impurities such as oxides, and oil from the surface of the particles of the powdered metal and to deposit upon the said particles a very thin but continuous film of the said further metal, such further metal having the property of resisting rapid oxidation and amalgamating readily with mercury.

Powdered copper is suitable for such method and it has also been found that other metals such as cobalt, iron, nickel and zinc can also be readily compounded with mercury if subject to such a pre-treatment. The intermediary metal may be, for example, palladium or tin.

The treatment solution may in general comprise an acid solution of a suitable salt of the further metal referred to above which metal may be a precious metal or a non-precious metal.

In one example of the method according to the invention wherein finely powdered copper is compounded with mercury, the treatment solution consists of an acid solution of palladium chloride, for example a one percent solution of palladium chloride in normal hydrochloric acid.

The invention is applicable also to the compounding of other powdered metals with mercury, for example, iron, nickel and zinc. Furthermore the salts of metals other than palladium may be used in the treatment solution. For example where the deposited metal is tin the plating solution may contain stannous chloride.

In the examples given above the metal powders may be washed in palladium chloride, but it should be appreciated that other plating solutions are possible, and in fact, are necessary with certain metals; for example palladium chloride is not a suitable pre-treatment solution for aluminum powder.

The particle sizes for which the method can be successfully employed include the range from 600's mesh down to 4–5 microns. These are not limitations imposed by the nature of the method and it is obvious that the lower limit may extend below 4 microns.

It is desirable that the solution used shall remove all impurities including inter alia oxides and oils, from the surface of the particles yet not erode the metal itself. It is also necessary that the solution shall impart to each particle a very thin but continuous film of a metal which does not oxidize rapidly but amalgamates readily with mercury. Several such solutions are possible. For example 1% palladium chloride in normal HCl. In the case where the plating metal is tin, a tin plating solution containing stannous chloride may be used.

The electrodeless plating operation used by the invention has the following points in its favour:

(1) No elaborate equipment required.

(2) The amalgams, although wet, are produced rapidly.

(3) When treating the smaller particle sizes 4–5 microns, for example, the particles are made "heavy" in that they tend to cluster together and sink to the bottom of the container, enabling them to be washed without loss, and making it easier to bring them into contact with the mercury. These small particles are of particular importance as their large surface area to volume ratio cuts down the time and work required to bring the amalgam to a "critical stage."

The term "critical stage" refers to the stage at which there is sufficient of the powdered metal dissolved in the mercury for the amalgam to set as opposed to the state in which the metallic particles are merely coated with mercury. "Critical" solutions in mercury of copper, nickel, and zinc and other metals are obtainable in this way. The product of the method may find application, for example, in the manufacture of spark-machining electrodes. One such material would be copper-tungsten, which is known for its resistance to arc-erosion and used as an arcing horn in air blast circuit breakers.

Example I

For the bulk preparation of a mercury-copper composition using the palladium chloride solution, the copper powder is first weighed into a vessel, then thoroughly wetted with a small quantity of water. The palladium solution is added and the powder agitated until a black precipitate of metallic palladium is seen. The powder is washed and the required quantity of mercury added. Further agitation produces an amalgam which can be dried, moulded into pellets, and stored for future use.

Example II

For making an iron amalgam 100 grams of 600 mesh iron powder is wetted thoroughly with a small quantity of water 30 cc. of 1% palladium-chloride in normal hydrochloric acid is added and the mixture is agitated and

afterwards rinsed; than 60 grams of mercury is added. Further agitation produces the amalgam.

Example III

For making a nickel amalgam 100 grams of nickel powder (of size 4–5 microns) is wetted thoroughly with a small quantity of water, to which is added 50 cc. of the palladium-plating solution followed by agitating and thorough rinsing. Mercury—say 60 grams—is then added and the mixture agitated further to produce the amalgam.

If to be used immediately, the amalgam may then be moulded to the desired shape using a suitable pattern and allowed to air harden. If it is desired to use amalgam which has been previously prepared and stored in pellet form, the pellets are warmed gently until small beads of mercury appear on the surface. The amalgam may be then moulded as above described. After the amalgam has set it is removed from the mould and heated in a sealed furnace in a reducing or inert atmosphere for the purpose of removing and recovering the mercury.

What I claim is:

1. A method of producing a metallic amalgam suitable for use in the precision casting of intricate objects comprising the steps of treating a powdered metal selected from the group of copper, iron, nickel, zinc, and mixtures thereof with an electrodeless hydrochloric acid plating solution of palladium chloride to deposit a thin film of readily amalgamated palladium metal on said powdered metal, and agitating the coated metal powder in contact with mercury to form an amalgam.

2. A method as claimed in claim 1 wherein said plating solution comprises a 1% solution of palladium chloride in normal hydrochloric acid.

3. A method of compounding finely divided metal powders with mercury to produce mouldable pellets comprising the steps of treating a powdered metal selected from the group of copper, iron, nickel, zinc and mixtures thereof with an electrodeless hydrochloric acid plating solution of palladium chloride to deposit a thin film of readily amalgamated palladium metal on said powdered metal, agitating the coated metal powder in contact with mercury to form an amalgam, drying the amalgamated powder, and moulding the dried amalgamated powder into pellets.

4. A method according to claim 3 wherein said plating solution comprises a 1% solution of palladium chloride in normal hydrochloric acid.

5. A method according to claim 4 wherein said powdered metal is copper.

6. A method according to claim 4 wherein said powdered metal is iron.

7. A method according to claim 4 wherein said powdered metal is nickel.

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