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DENTAL INVESTMENT COMPOSITION

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This invention relates to compositions of matter and has reference more particularly to compositions suitable for use in mechanical dentistry.

In the casting of partial dentures, it is common practice to make an impression of the mouth with a composition commonly known as a "dissolving impression plaster". Using the impression cast as a mold, a model is cast from an investment compound which ordinarily consists of a mixture of plaster of Paris and fine silica in approximately the ratio of 30 parts silica to 70 parts plaster of Paris. Small amounts of other ingredients, such as boric acid or graphite, are sometimes added to give certain desirable effects. After the model has set, both model and mold containing same are placed in boiling water until the mold is entirely disintegrated. The model remains intact and represents accurately the exact shape of the mouth to which the denture is to be fitted. On this model is built up in wax a pattern of the denture which will eventually be installed in the mouth. The model with wax pattern is then placed in a metal flask and an investment compound in plastic state is poured around the model, this composition being usually the same as employed for the model. After this investment has set, the wax is boiled out and the whole is heated to a temperature ranging from 300° to 600° F., for a period of 12 to 16 hours in order to thoroughly calcine the plaster and remove all traces of wax. The flask containing the investment is then placed in a gold casting machine and molten gold or other metal or alloy is cast into the depression left by the wax. After cooling, the plaster is scraped away and the denture is cleaned and polished ready for insertion in the mouth.

The technique described above is known as the low heat technique of preparing partial dentures. It is necessary to use a rather low proportion of silica with respect to plaster in order that the model may be immersed in boiling water for a considerable length of time and still retain sufficient strength and hardness to prevent its disintegration. A mixture of this type may not be burned to a high temperature of say 900° to 1600° F. because at these temperatures, the material is liable to warp or crack and undergo considerable contraction. It is desirable that investment compounds of this type possess the property of expanding from 0.7–1.0% on being heated to the maximum temperature employed in burning out the wax and calcining the plaster in order to compensate for shrinkage of the gold from its melting point temperature to mouth temperature. Thermal expansion of investment compounds is increased by increasing the amount of silica present. Also, the use of a high silica ratio enables us to burn out the investment at a higher temperature than is possible with a low silica ratio without warping and cracking of the mold. A high silica content is therefore very desirable in order to secure the necessary thermal expansion and other desirable characteristics described. Heretofore it has been impossible to use a high silica low plaster formula for this type of work, because of the fact that formulas of this type will tend to disintegrate in boiling water when the dissolving impression plaster is removed, thus leaving a soft and crumbly surface which may be untrue to dimension and which will result in final rough and ill-fitting dentures.

An object of this invention therefore is to produce an investment composition which has a high thermal expansion.

Another object of the invention is to produce an investment composition which may be burned at high temperatures in a short period of time to remove the wax, without disintegration or cracking.

A further object of the invention is to provide an investment composition which will produce high quality dentures, the same being not only true to dimension but also having smooth, hard molding surfaces exactly shaped to the mouth; also to improve investment compositions in other respects hereinafter specified and claimed.

In the copending application of Randel and Dailey, Serial No. 384,343, filed August 9, 1929, and entitled "High strength calcined gypsum", a new high strength calcined gyp-

sum is described, together with its method of manufacture. This high strength calcined gypsum has unique properties in that its compressive and tensile strength equal or exceed that of Portland cement, whereas its setting time is approximately that of ordinary plaster of Paris, viz., 15 to 30 minutes. The compressive strength of this product will range from 2500 to 5750 pounds per square inch and it has a pouring consistency of less than 50%. This high strength calcined gypsum which I shall in the future designate as alpha gypsum, is manufactured by treating lumps of gypsum rock having a diameter of ½" to 2" in a closed container with steam at 17 to 20 pounds gage pressure. Steam at 15 to 50 pounds pressure may be used but outside of the preferred range of 17–20 pounds gage, the strength and quality of the resulting product diminishes. This steam calcination is carried on for 5 to 7 hours with a constant steam pressure and with a constant withdrawal of water of condensation obtained from the heating steam and also from the expelled water of crystallization. After calcination, the product is dried while maintaining at a temperature under 400° F. and the product is ground so that 85% or more of same passes through a 100 mesh screen. The crystals of ordinary first settle calcined stucco as seen under crossed nicols in a petrographic microscope, are very fine and needle-like, these crystals being mostly less than 5 microns in diameter. The crystals of alpha gypsum when examined at the same magnification under the same microscope, appear rather short, thick and well formed. The crystals of alpha gypsum are practically pure crystalline calcium sulphate hemihydrate, and when examined under this microscrope, they appear brilliantly colored, while little or no color is visible in the case of the tiny needle-like crystals of ordinary plaster of Paris. The unique properties of our improved alpha gypsum, together with another cooperating gum ingredient, has enabled me to prepare an investment composition which has many marked advantages.

The preferred formula is as follows:

	Grams
Alpha gypsum	40
Powdered silica	60
Gum arabic	½

Water about 33 cc. per 100 grams of dry mix.

Sufficient retarder or accelerator is used to give a product having the desired time of set. Small amounts of other materials may be added, if desired, to give greater thermal expansion or improve other characteristics of the compound. Water is added to the mixture to bring to molding consistency and this combines with the calcined gypsum to form hydrated gypsum.

The alpha gypsum in the above formula may be varied from 30 to 70 gms., the powdered silica from 30 to 70 gms., and the gum arabic from ¼ to 2 gms. with varying results. Tapioca dextrine, and other hardening agents may be used instead of the gum arabic and powdered flint, quartz or other siliceous fillers may be used instead of the powdered silica. When alpha gypsum is used, the gum arabic becomes a desirable but non-essential ingredient, and when gum arabic is used, the alpha gypsum becomes a desirable but non-essential ingredient and other forms of calcined gypsum, such as plaster of Paris, may be substituted. In some cases the retarder or accelerator may be omitted. Common accelerators known to the art are finely ground gypsum, potassium sulphate, alum, etc. Commonly used retarders are hydrolized protein matter, known as "commercial retarder" and such chemicals as soluble citrates, phosphates and acetates. The alpha gypsum is preferably ballmilled but may be ground otherwise to pass a 100–150 mesh screen.

My improved investment composition may be burned at a high temperature, say 900° to 1600° F. and the wax is completely burned out in a period of thirty minutes to one hour as contrasted with the burning time required in other compositions of 12 to 16 hours. Because of the high silica content, the composition has a high thermal expansion of about 0.75 percent at casting temperatures, with the result that it is possible to obtain proper dimensions of the finished denture. The cast composition may be immersed for long periods of time in boiling water and still retain a hard surface true to dimensions. This latter property of resisting boiling water is imparted to the composition especially by the gum arabic. This gum arabic in the mix imparts to the calcined gypsum the property of great hardness and of resistance to loss of strength upon wetting.

I would state in conclusion that while the illustrated examples constitute a practical embodiment of my invention, I do not wish to limit myself precisely to these details, since manifestly, the same may be considerably varied without departing from the spirit of the invention as defined in the appended claims.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. An investment composition comprising a mixture of the following ingredients:

	Grams
Alpha gypsum	40
Powdered silica	60
Gum arabic	½

2. An investment composition comprising alpha gypsum, a powdered siliceous material, and gum arabic.

3. A composition of matter comprising

alpha gypsum, a siliceous filling material, and a hardening agent.

4. An investment composition comprising alpha gypsum, tapioca dextrine, and a siliceous filling material.

5. A composition of matter comprising alpha gypsum, powdered silica, gum arabic, retarder, and boric acid.

6. An investment composition comprising alpha gypsum 30–70 grams, siliceous filling material 30–70 grams, gum arabic ¼–2 grams and retarder or accelerator sufficient to bring to the desired set with water.

7. An investment composition comprising alpha gypsum, a siliceous filling material, gum arabic and commercial retarder.

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