

Original Article

Setting time of construction gypsum, dental plaster, and white orthodontic gypsum

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Abstract

Background. Dental plaster, white orthodontic gypsum, and construction gypsum have β -hemihydrate particles. Setting time is an essential property of dental gypsum, which can affect the strength of the material. This research aimed to compare construction gypsum, dental plaster, and white orthodontic gypsum's initial and final setting times.

Methods. Three groups were included in this experimental laboratory study: construction gypsum (A), dental plaster (B), and white orthodontic gypsum (C). Each group consisted of 10 samples. Gypsum manipulation consisted of using 120 gr of powder and 60 mL of water. Gypsum powder and water were mixed using a gypsum mixer at 120 rpm. A homogeneous mixture was poured into a mold, and the setting time was measured using a Gillmore needle, according to ASTM C03-366. The initial setting time test was measured using 113.4 grams and a -2.12mm needle. The final setting time was measured using 453.6 grams and a -1.06mm needle. This test was repeated until the needle failed to penetrate the gypsum's surface. All the data were analyzed with one-way ANOVA and post hoc Tukey tests using SPSS 23.

Results. The average initial setting time for groups A, B, and C were 1.40 ± 16.17 , 1.19 ± 10.39 , and 1.51 ± 24.46 , respectively. The average final setting time for groups A, B, and C were 0.79 ± 15.97 , 0.88 ± 24.31 and 0.66 ± 33.37 , respectively. One-way ANOVA and post hoc Tukey tests showed significant differences in the initial and final setting times between the three groups ($P<0.05$).

Conclusions. There were differences in setting time between dental plaster, white orthodontic gypsum, and construction gypsum. The construction gypsum's setting time is suitable as a type II dental gypsum, according to ADA No.25.

Introduction

Gypsum is one of the natural minerals that contain calcium, hydrogen, water, and sulfur, known as calcium sulfate dihydrate ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$).¹ Gypsum products are available in the form of a fine white powder which has undergone calcination or heating at a temperature of 110-130°C in the open air. This process causes some of the gypsum material to become dehydrated to calcium sulfate hemihydrate ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) called Plaster of Paris in the form of β -hemihydrate.^{2,3,4}

Construction gypsum is used in the manufacture of gypsum boards or ceilings in the building interior industry.⁵ Gypsum is the material of choice because it has a low price, is easy to install, and has characteristics that meet the criteria as building materials. Construction gypsum material is in the form of β -hemihydrate with the characteristics of low density and high porosity.⁶ This gypsum form of hemihydrate becomes hydrated when mixed with water and undergoes the process of setting. At the

same time, there is an increase in the strength of the material because the final microstructure of set gypsum material can affect the gypsum stiffness.^{4,7}

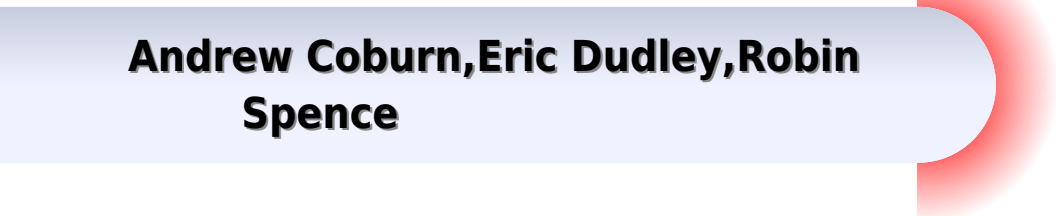
Type II dental gypsum or dental plaster contains β -hemihydrate particles and is used as a study model material, a set-up material for the working model on articulators, and dental laboratory material. Orthodontic white gypsum containing β -hemihydrate particles is used as a study model in orthodontics to provide a three-dimensional picture of the patient's occlusion, making it easier for dentists to determine treatment plans.⁸ The material in dentistry should have the characteristics that affect the strength, such as setting time.⁹ The setting process starts when the gypsum powder is mixed with water (hydration). There are two time intervals: initial setting time and final setting time, when setting time is in progress. The time from mixing gypsum powder with water until half-hardened gypsum consistency is achieved is called the initial setting time, while the final setting time is the time from mixing until the material hardens and can be removed from the mold.

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