Evaluation the effect of mixed different types of water with dental stone on the compressive strength.

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Abstract:

The strength of gypsum products is generally expressed in terms of compressive strength and normally measured under compression. It increases rapidly as the materials harden after the initial setting time. However, the amount of water present in the set product definitely affects its strength.This study is designed to evaluate and compare the effect of water used (tap water, distilled water, tap water with powder of stone, distilled water with powder of stone, tap water with impurities of stone, distilled water with impurities of stone) on compressive strength of dental stone.Sixteen (60) specimens were prepared from stone, (10) specimens were considered as a control group (tap water) the remaining specimens were divided into five main group (10) specimens of distilled water, (10) specimens of distilled water with powder of stone (10) specimens of distilled water with impurities of stone (10) specimens of tap water with powder of stone, (10) specimens of tap water with impurities of stone.The result showed that the group of distilled water has increase the compressive strength than control group (tap water), and group of tap water with impurities of stone has decreased compressive strength than control group (tap water).Finally, it can be concluded that the type of surface treatment have an important parameter in the improvement of dental stone.

Introduction:

Gypsum products have different form of gypsum that used since many centuries for construction purpose in dentistryPlaster has been used for making dental casts since 1756, and for making impression since 1844 and which consist of porous, irregularly shaped crystals. Plaster was the only gypsum product used in dentistry until 1920 when dental stone was developed. In (1933) a patient was granted on a high strength plaster which was produced by heating gypsum under the steam pressure in an autoclave. The new products are call alpha-calcium sulfate hemihydrates (CaSo4.x H2o) or stone which consists of dense, regularly shaped, relatively non porous, cuboidal crystals (Ridge and Boell , 1964). Because of the particle characteristics, the alpha stone requires less gauging water and are about 21/2 time stronger than the beta plaster because the irregular shapes of the plaster particles prevent them from fitting together tightly (Hoggart, 1952). patented a method for containing gypsum by boiling it in a 30 percent solution of calcium chloride (CaCl2).The crystals resulting from this process are slightly larger, more dense referred to as " die" stones due to their strength that makes them suitable for inlay, crown and bridge casts.

Several study have studied the gypsum materials for nearly two centuries, beginning with proposed a theory for the hardening of plaster of paris which is generally regarded as correct today (Lyon et al, 1987; and Chafee et al., 1997).In these study different types of water was used through mixing of gypsum products and to determine the effect of each type on the compressive strength of the dental stone.

Materials and Method:

Materials used in the present study are:

Dental stone type (III)/titan silo-tambour 4 6028 reccastrada (GR) Italy. Tap water and Distilled water .

Method:

Sixteen specimens (60) were prepared from dental stone (10) specimens for each surface treatment, this study includes (6) groups of specimens depending on the different surface treatments that is:-

Group A: tap water (control group).

Group B: tap water with powder of stone.

Group C: tap water with impurities of stone.

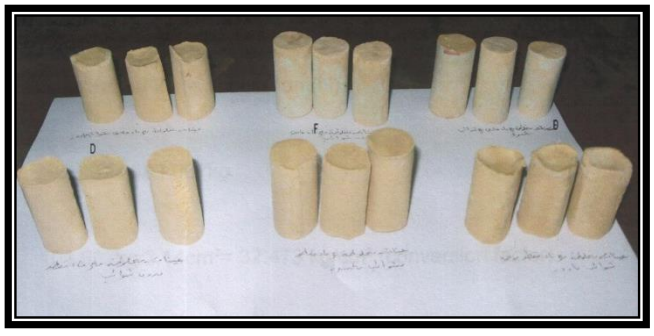
Group D: distilled water.

Group E: distilled water with powder of stone.

Group F: distilled water with impurities of stone.

From metal cylinder were constructed with different dimension of (40mmX20mm) height and diameter respectively and then specimens were prepared by using metal mould which was filled with dental stone mixed according to manufacturer's instruction, (31ml/100mg) procedure was performed for each group as follow, (group A) mix tap water with powder and then the mix was poured down the side of the inclined mould, the mix gently vibrated to into the mould and glass slab was placed over the mould pressed firmly into contact with the top surface of the mould to ensure flat parallel ends, the stone was allowed to set for 30 minutes before being separated from the mould, then the glass slab was taken off the mould and the cylindrical samples were easily removed from the mould at 30 minutes from the start of mixing, same procedure for preparing (group B) except using tap water with powder of stone, same procedure for (group C) except using tap water with impurities of stone, same procedure for (group D) except using distilled water, same procedure for (group E) except using distilled water with powder of stone, same procedure for (group F) except using distilled water with impurities of stone, as shown in figure (1).

Compressive strength of dental stone specimens were measured by compressive testing machine with 500kg load cell across head speed of 0.05cm/min. The specimens were placed on the testing machine which near top and bottom of the specimens were in contact with steel, flat plat, as shown in figure (2).



compressive

Figure (2): Specimens under compressive strength machine.

The specimens were loaded to failure under loading rate of 350kg/cm^2/min for stone. The maximum load carried by the specimens was recorded in kilo-newton (KN) and taken from the digital screen of the machine, and then all the values were converted to kg/cm^2 by using this formula:

KN X 32.473=kg/cm^2

K Newton (KN) = 10 Newton (N)

N/9.807=101.967kg

101.967kg/3.14cm^2 = 32.473 kg/cm^2 (conversion factor).

Results:

Descriptive and inferential statistics of compressive strength of the control groups of stone and the specimens of the stone poured by using different types of water: group A, B,C,D,E,F respectively.

In table (1) for stone some of descriptive statistics are listed (mean, standard deviation, standard error, and minimum, maximum).

Table (1): mean distribution of compressive strength among studied groups.

Groups statistics	Tap water (control group) (A)	Tap water with powder (B)	Tap water With impurities (C)	Distilled Water (D)	Distilled water with powder (E)	Distilled water with impurities (F)
mean	26.3	25.8	15.9	31.7	31.7	24.8
S.D	0.64	0.96	0.87	1.01	1.02	0.69
S.E	0.265	0.392	0.357	0.409	0.410	0.285
Min.	25.3	24.1	15.0	30.4	30.2	24.2
Max.	27.1	26.6	17.3	32.8	32.7	26.1

S.D = standard deviation
S.E = standard error
Min = minimum
Max = maximum

The result showed that the highest compressive strength the mean values were obtained in (distal water) and (distal water with powder of stone) (31.7 kg/cm2), while the lowest compressive strength values were obtained in (tap water with impurities of stone) (15.9kg/cm2) respectively, as shown in figure (3).

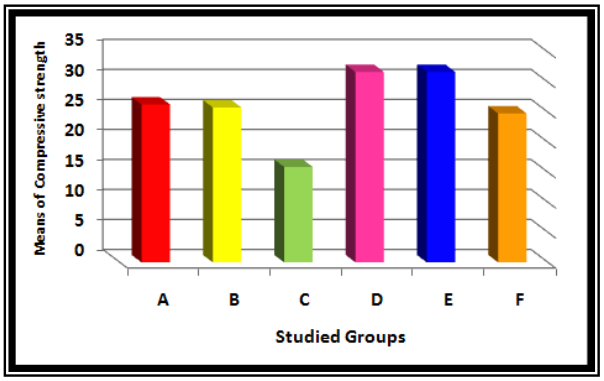


Figure (3): the mean value of control and experimental groups for compressive strength test.

For compressive strength for all tested groups, the analysis of variance (ANOVA) test revealed highly significant differences between the test groups ($p < 0.01$) as showed in table (2).

Table (2) the ANOVA test for compressive strength among studied groups.

ANOVA Test	Sum of squares	df	Mean Square	f	P-value	significant
Between groups	1014.227	5	202.845	264.313	0.00	Highly sig. (p<0.01)
Within groups	23.023	30	0.767			
Total	1037.250	35				

The least significant difference (LSD) test result showed that all tested groups showed a highly significant difference ($p<0.01$) except group (A) with (B), group (B) with (F) and group (D) with (E) which showed no significant difference as showed in table (3).

Table (3): the least significant difference (LSD) of multiple Comparison tests for compressive strength among studied groups

Studied groups		LSD(F-test)	
		p-value	Sig.
A	**B**	0.347	Non sig.(p<0.05)
	C	0.00	Highly sig.(p<0.01)
	D	0.00	Highly sig.(p<0.01)
	E	0.00	Highly sig.(p<0.01)
	F	0.007	Highly sig.(p<0.01)
B	**C**	0.00	Highly sig.(p<0.01)
	D	0.00	Highly sig.(p<0.01)
	E	0.00	Highly sig.(p<0.01)
	F	0.061	Non sig.(p<0.05)
C	**D**	0.00	Highly sig.(p<0.01)
	E	0.00	Highly sig.(p<0.01)
	F	0.00	Highly sig.(p<0.01)
D	**E**	0.819	Non sig.(p<0.05
	F	0.00	Highly sig.(p<0.01)
E	**F**	0.00	Highly sig.(p<0.01)

Discussion:

The strength of gypsum materials is normally measured under compression for

dental plaster or stone great strength is often required, since inadequate strength may result in fracture or distortion of the cast or mould during the fabrication of dental application (Ridge, and Boell, 1964; Bailey et al., 1988; and Al-Fahadawy, 1999;).

In the present study show that high compressive strength in distal water and distal water with powder compared with the tap water (control group).These may be related to that distilled water have not contain any types of impurities because that give regular shape and no relatively no porous and more dense dental stone (Combe and Smith, 1964; Craig and Powers, 1979; Diakoyanni et al.,1992), this impurities have decrease the inter crystalline cohesion and lead to lower compressive strength and also due to the chemical reaction between impurities particles and component of dental stone (Paffenbarger and Beall, 1938; Overberger and Samay, 1968; Manson1970; and Kenneth1994), while the distilled water with impurities decreased the strength compared with the control group (tap water) these result may be due to irregular shapes of dental stone particles because this irregulates lead to many spaces which have brittle in nature and cause porous surface which lead to lower compressive strength than the control group(Consani and Ruhnke, 1975;Sanad et al(1982); McCabe, 1985; and Ramzi, 2001).

Conclusions:

Dental stone specimens mixed with tap water and impurities of stone produce decreased the strength when compared with other groups and control group while specimens mixed with distilled water was significantly superior to other specimens mixed with (tap water with powder of stone, tap water with impurities of stone, distilled water with powder of stone, distilled water with impurities of stone) and control group.

1. Mixed of the dental stone with (distilled water, tap water with powder of stone, tap water with impurities of stone, distilled water with powder of stone, distilled water with impurities of stone) improved transverse strength.

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الخلاصة:

قوة المنتجات الجبسية بصورة عامة تعتمد على القوة الضاغطة التي تقاس تحت الضغط يزداد تصلب هذه المواد بعد التصلب الأولي الابتدائي علماً أن كمية الماء تؤثر على قوة المنتجات الجبسية. في هذه الدراسة تم تقيم ومقارنة تأثير الماء المستعمل (ماء الحنفية، ماء المقطر، ماء الحنفية مع الجزئيات حجر الكلس، ماء المقطر مع جزئيات حجر الكلس، ماء الحنفية مع شوائب حجر الكلس، ماء المقطر مع شوائب حجر الكلس) على القوة الضاغطة لمادة حجر الكلس. (60) عينة حضرت من حجر الكلس و (10) عينات المجموعة القياسية (ماء الحنفية) والبقية قسمت إلى خمسة مجاميع وهي (10) عينات (ماء المقطر) و (10) عينات (ماء المقطر وحجر

الكلس) و (10) عينات (ماء المقطر مع شوائب حجر الكلس) و (10) عينات (ماء الحنفية مع حجر الكلس) و (10) عينات (ماء الحنفية مع شوائب حجر الكلس). أظهرت النتائج أن المجموعة (ماء المقطر) قد زادت من القوة الضاغطة أفضل من المجموعة القياسية (ماء الحنفية) ومجموعة ماء الحنفية مع شوائب حجر الكلس قد قللت من القوة الضاغطة مقارنة مع المجموعة القياسية (ماء الحنفية).

وفي النهاية يمكن الاستنتاج بأن نوع المعالجة السطحية تمتلك مقياس مهم في تحسين حجر الكلس.