

# 石膏製品에 促進劑 使用時 硬化時間 및 硬도에 미치는 影響에 關한 實驗的 研究

동우전문대학 치기공과

=Abstract=

## An Investigation of How the Accelerator Effects the Setting Time and The Headness of Plaster Products

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This investigation is carried out of inquirie into the effects of the accelerator on the setting time and haedness when it is used with plaster products.

Plaster( ), dental hard stone( ), and limproved dental hard stone(M ) are selected as the objects of the investigation, since they are most common materials for dental plaster products.

Setting time is gauged by means of Vicket Needle and Gilmore Needle, and hardness is gauged by means of Brinell and Vicket Hardness machines.

Samples of each material are made in the standerd water powder ratio and with the accelerator repectively, Every material is tested five times each.

The results of the tests are as fillow :

- 1) In each case the setting time is shortened when the accelerator is used.
- 2) Of the three materials the hardness of the plaster was lowest  
 $A( ) < B( ) < C(M )$
- 3) In each case the hardness of the samples made in the standard water powder ratio were higher than that of the sample made with the accelerator.  
 $A1 > A2 ; B1 > B2 ; C1 > C2$
- 4) Final Conclusion : Higher quality cast is expected when it is made in the standard water powder ratio.

# 차 례

## Ⅰ. 序 論

- 1. (1) • 가
- 2. 1) • 가
- 2) • 가
- 3) Vicket (2) • (wax up)
- 4) Gilmore • (wax up)
- 3. 1) • 가
- 2) Brinell Hardness (3) • 가
- 3) Vickers Hardness : Hv • 가
- 가
- 가
- 가
- (die : ) 가
- 가

## Ⅰ. 序 論

(gypsum products) 가 mixing (accelators) , KCl, NaCl, K<sub>2</sub>SO<sub>4</sub>, Na<sub>2</sub>SO<sub>4</sub> 2~4% NaCl( ) 가 King Solomon (alabaster) NaCl( ) (hardness test)

(impression) , (casts) (dies) , (articulator) , (dental resin) (processing) , (molds) (gypsum bonded Investment) (binding materials) , index

## Ⅱ. 실험대상 및 방법

### 1. 실험대상

( ) plaster (dental stone) (dental improved stone) ( 1).

1.

종 류	제품명	제 조 회사	표준 혼수비	촉진제
보통석고( $\beta$ )	plaster	문 교 (Korea)	40~50	NaCl 0.9% 대한약품주
경질석고( $\alpha$ )	Neo plum stone	목화학공업주 (Japan)	20~30	NaCl 0.9%
초경질석고( $M\alpha$ )	Fuji Rock	G. C(Japan)	20~25	NaCl 0.9%

) 가

JIS

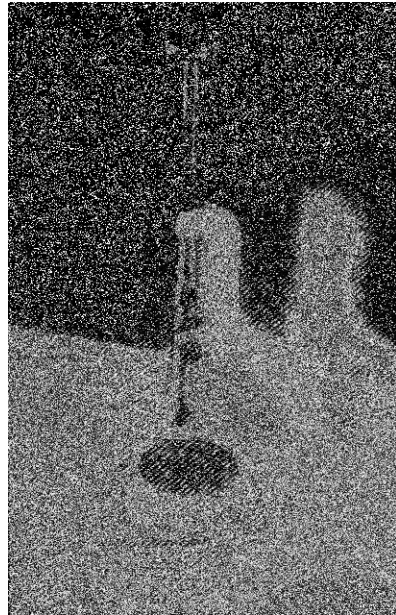
- 100ml 가 가
- 10ml 2 120g
- 40 ± 1mm가

## 2. 경화시간 측정

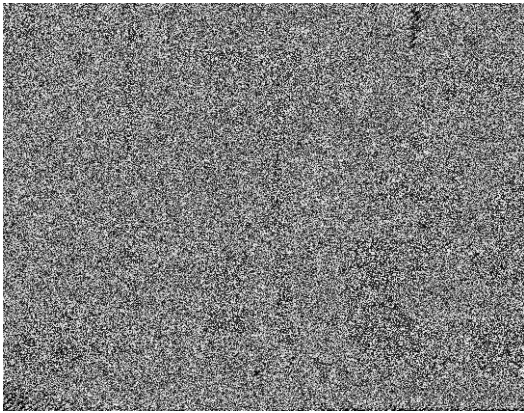
1)

a. a, b  
( , , 1 )  
0.9%  
(50 )  
가 rubber bowl spatula  
上皿天坪  
(25ml)

parafin wax wax spatula  
(gauze)  
가  
a. Vicket ( )  
1) JIS  
Vicket ( 2mm 300g)  
( ring 50mm)



1. Vicket Needle  
300g 2mm



2)

가 :  
 JIS 가 ( 3)  
 100g 30 100rpm(1  
 30 ) 2  
 100 ) 2

2. Gilmore needle ( ) :  
 1/12 ( 2.1mm),  
 1/4pound(113g) 2 ( ):  
 1/24 (1mm), 1 pound(453g)

rubber bowl  
 100rpm spatula rubber bowl  
 spatula  
 vibrator

가

b. Gilmore

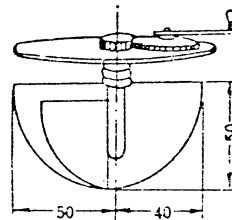
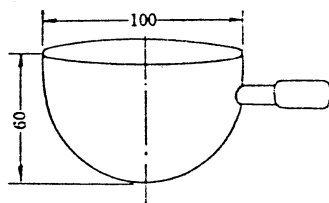
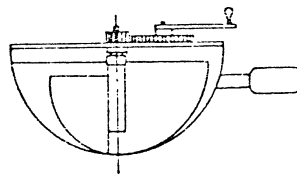
2) ADAS

Gilmore (1/12inch , 1/4pound  
 1/24inch , 1pound(453g)  
 (1.06mm)  
 ring 13~15mm

, 가  
 가

조립도

단위 mm

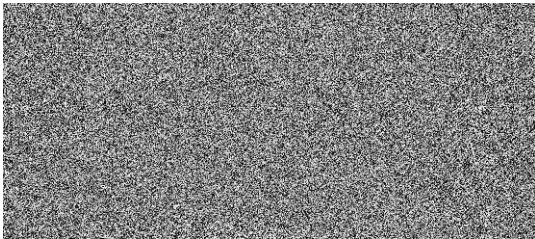


3. JIS

### 3) Vicket

1. Parafin wax 14.5cm 1.5cm

4.5cm 1.5cm ( 4).



4.

2. 가 가

가

3. 50g

4. Vibrator paraffin wax

5. vicket

가

spatula

6. 2 30

stop ( 1) Vicket vicket

7. 1 Vicket ( stopper gauze

1b) ( a)

Vicket

8. Vicket

( b)

9. data sheet

graph

가

1mm

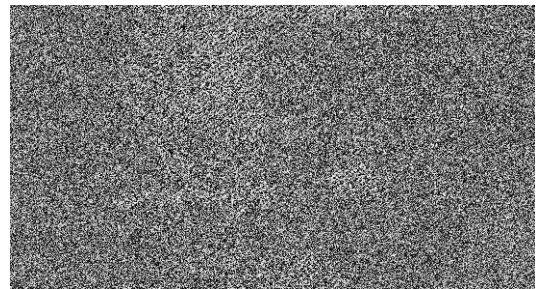
### 4) Gilmore

1. wax a. 4

2. wax 가

3. wax 1 1/4 1b Gilmore

( 5).



5.

4. 가 1lb Gillmore

5. 가

2.

석고종류	보통석고	경석고	초경석고
혼수비	표준(w/p) 40	표준(w/p) 24	표준(w/p) 20
수용액의 종류	0.9% 식염수	0.9% 식염수	0.9% 식염수
측정시간	1시간 후	1시간 후	1시간 후

### 3. 석고의 경도 측정

1)

- a, b  
( , , 1 )  
, 0.9%  
rubber bowl spatula  
(25ml)

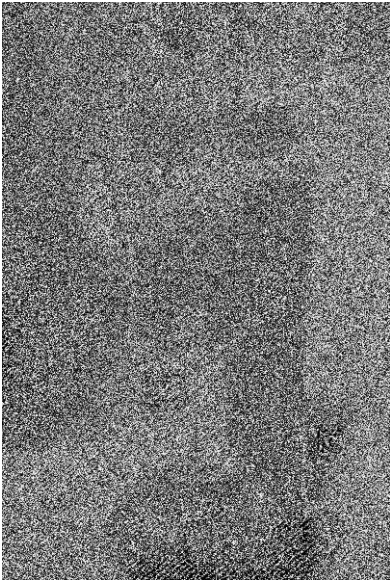
, Mold

a. Brinell Hardness

Brinell Hardness ( 1.5 ~ 5.0mm  
, 5 ~ 50kg)

b. Vickers Hardness ( 136  
, 5 ~ 1000g)

#### 2) Brinell Hardness



6.

- a:      b:      c:  
d:  
e:

1.

1.5cm      1.7cm      mold      가      3cm  
block

2.

< 6 >  
1.5 ~ 5.0mm      5 ~

50kg

3.

< 7 >      (d)  
(A)

$$A = \frac{1}{2} \{ \pi D (D - \sqrt{D^2 - d^2}) \}$$

, D :      (mm)

d :      (mm)

$$H = \frac{P}{A} = \left\{ \frac{2P}{\pi D (D - \sqrt{D^2 - d^2})} \right\}$$

4.

H(1.5-50-30)

H(1.5/50/30)

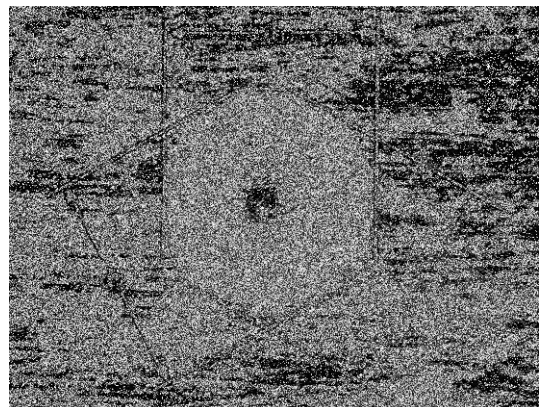
(mm), 50      (kg), 30  
( )      )

5.

10

6.

4

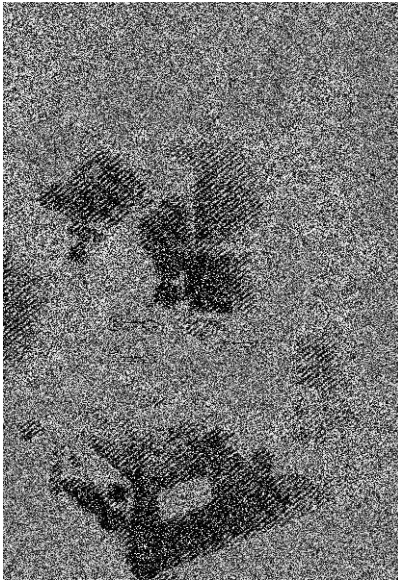


7. Brinell Hardness

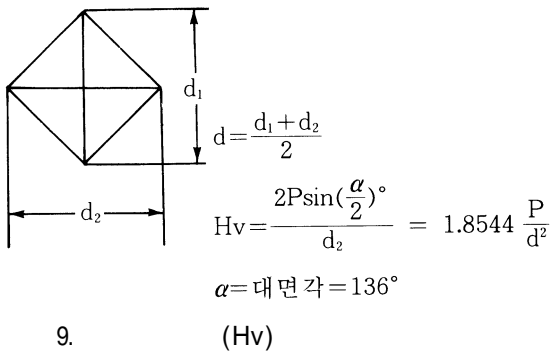
7. 0.3~0.5가

8. 가 30

3) Vickers Hardness : Hv



8. a: b: c: d:



1. < 8> 136  
5~1000kg  
2. (d)

< 9>  
3.  $A = \frac{1}{2} \cdot d^2 / \sin \frac{\alpha}{2}$

$$(Hv) = \frac{P}{A} = \frac{2P \sin(\frac{\alpha}{2})}{d^2}$$

$$= 136 \cdot \frac{P}{d^2}$$

, d = (mm) / P = (kg)

SI

$$N = (2-2) \quad Hv$$

$$= 0.102 \frac{P}{A} = 0.18909 \frac{P}{d^2}$$

III. 실험성적

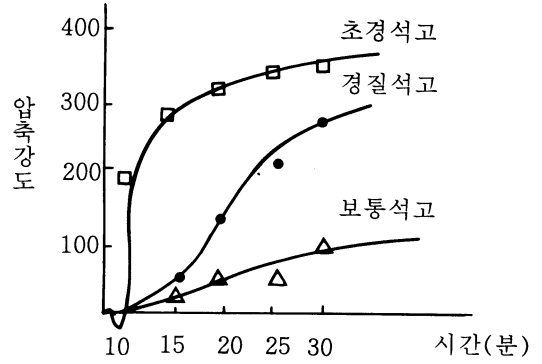
1. 경화시간 측정

a. Vicket ( 1)  
JIS /300g,  
2mm Vicket  
가 1mm  
< 3>

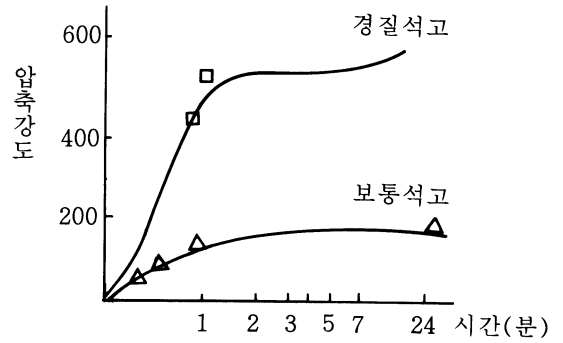
3.

석고의 종류		표준혼수비	경화 시간(분)		
JIS	ADAS	ml/100 g	JIS	ADAS	시판품
보통석고 (β)	plaster	40~50	0~30	10+3	10~30
경질석고 (α)	dental stone	20~30	5~30		5~10
초경질 석고 (Mα)	dental stone high strength	20~25			7~15

b. Gilmore ( )  
 2) ADAS 1/4  
 pound, 1/12inch  
 pound(435g), 1/24 (1.06mm)



가 가 가  
 < 10>  
 JIS ADAS  
 ( )  
 < 4>



2) (a. Brinell Hardness) GA: 1/4pound GB: 1pound  
 < 6> V:

4.

취급방법	경화시간	경화팽창	압축강도
혼수비가 작다	짧아(빨라)진다	커진다	강해진다
콜로이드실리카액으로 연화하면	짧아(빨라)진다	커진다	강해진다
연화시간이 길면	짧아(빨라)진다	약간 커진다	강해진다
연화횟수가 많으면	짧아(빨라)진다	약간 커진다	강해진다
진공(감압) 중에서 연화하면	큰차이없다	약간 커진다	강해진다
수온이 높으면	짧아(빨라)진다	커진다	
경화 촉진제	짧아(빨라)진다	작아진다	약해진다
경화 지연제	길어(느려)진다	작아진다	약해진다
석고의 분말이 작으면	짧아(빨라)진다	작아진다	약해진다
석고의 액으로 연화하면	짧아(빨라)진다	작아진다	약해진다
풍화한 석고	짧아(빨라)진다	작아진다	약해진다



1.5 ~ 5.0mm                      5 ~ 50kg  
 (                      7 )                      (d)  
 (A)

$$A = \frac{1}{2} \{ \pi D(D - \sqrt{D^2 - d^2}) \}$$

D (mm)  
 d: (mm)

$$H_B = \frac{P}{A} = \left\{ \frac{2P}{\pi D(D - \sqrt{D^2 - d^2})} \right\}$$

b. Hv : Vickers Hardness

< 8 >

5 ~ 1000g

9 >

$$A = \frac{1}{2} \cdot d^2 \cdot \sin \frac{\alpha}{2}$$

$$(Hv) = \frac{P}{A} \frac{2P \sin(\frac{\alpha}{2})}{d^2}$$

$$= 1.8544 P/d^2$$

D = (mm) / P = (kg)

SI

$$H = 0.102 = 0.18909$$

136

(d) <

종류	조건	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	X <sub>4</sub>	X <sub>5</sub>
A (10 g)	A <sub>1</sub>	7.8	9.9	8.5	8.7	7.7
		7.4	8.9	6.7	6.9	7.3
	A <sub>2</sub>	3.2	1.6	5.2	3.0	3.8
		3.8	4.9	5.7	3.9	5.4
B (25 g)	B <sub>1</sub>	33.1	27.4	58.3	42.4	50.5
		49.5	44.2	43.1	44.7	46.1
	B <sub>2</sub>	35.3	20.9	27.0	15.4	18.8
		22.4	18.5	26.8	30.2	31.1
C (50 g)	C <sub>1</sub>	55.1	66.5	60.9	71.3	47.6
		73.6	68.8	43.8	46.6	56.5
	C <sub>2</sub>	34.2	46.8	40.1	38.9	37.4
		43.3	45.2	36.4	41.4	20.7

A : Plaster(β)    B : Dental stone(α)

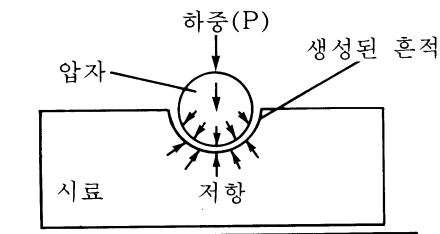
C : Dental stone(Mα)

A<sub>1</sub> : 표준 혼수비    B<sub>1</sub> : 표준 혼수비

C<sub>1</sub> : 표준 혼수비    A<sub>2</sub> : 촉진제

B<sub>2</sub> : 촉진제            C<sub>2</sub> : 촉진제

11 >



$$H = \frac{P(\text{하중})}{A(\text{흔적의 표면적})}$$

11.

#### IV. 고찰

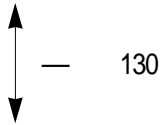
( ) Plaster model,  
 ( ) Dental stone, (M)  
 Dental stone high strength 3 가

가

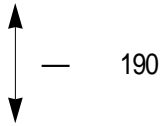


2 가

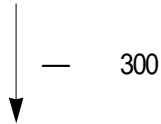
CaSO<sub>4</sub> · 2H<sub>2</sub>O(安定)



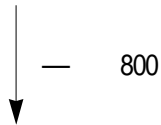
CaSO<sub>4</sub> · 1/2 2H<sub>2</sub>O(準安定)



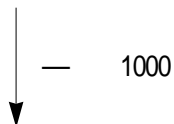
CaSO<sub>4</sub> (準安定, 可溶性無水鹽)



CaSO<sub>4</sub> (安定, 不用性無水鹽)



CaSO<sub>4</sub> ( )



CaO + SO<sub>2</sub> + O<sub>2</sub> (分解)

2

가

3

가

CaSO<sub>4</sub> · 2H<sub>2</sub>O( )

가

130 180

110 150

30% CaCl<sub>2</sub>

110 150

가

3

CaSO<sub>4</sub> · 1/2 H<sub>2</sub>O

가

가

2 가

CaSO<sub>4</sub> · 1/2



: 4100 Cal/Mol

: 4600Cal/Mol가

Le chatelier van t Hoff

25

0.6%

0.9%,

0.2%

0.7~0.4

2

5

30

가

( )

( )

( )

( )

( )

( )

( )

( )

( )

( )

( )

( )

JIS

ADAS

( )

( )

( )

2~3

2

가

가

가

가 300rpm

600rpm

가

40

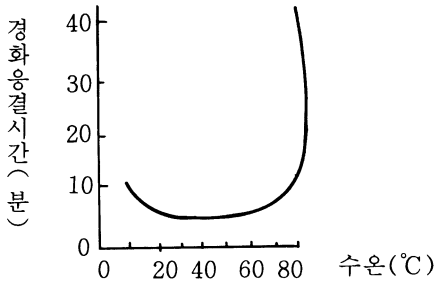
가 가

가

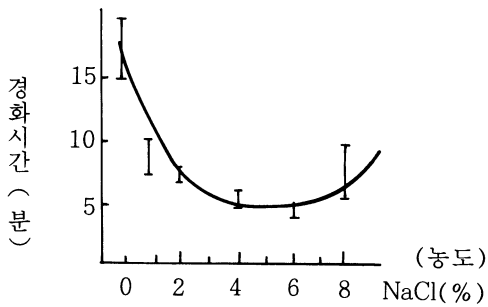
85

( 12).

1



12.



12.

NaCl K2SO4  
 < 13>  
 (NaCl) 가 8% 6% 6%

가

time

(w/p ratio)

working

가

## V. 결론

Vicker needle Gilmore needle  
 Brinell Hardness Vickers  
 hardness 5

1) 3

2) 3

가 가

{ A( ) < B( ) < C(M ) }  
 가

3)

A1 > A2, B1 > B2, C1 > C2

4)

가

## 참고문헌

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