GYPSUM MATERIALS

Prof. Dr.

Mohammed AL-Khafagy

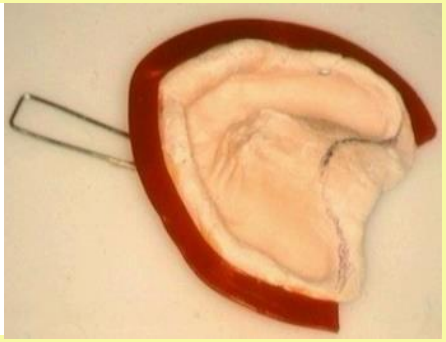
THIS LEC…….

- *What is the gypsum products.*
- *What are the application of gypsum products in dentistry.*
- *What are the ideal properties of gypsum products as model material.*
- *What the methods used in production of gypsum materials.*
- *Who to manipulate the gypsum products and what are the factors affect the properties of this materials.*

The mineral gypsum $CaSO_4 \cdot 2H_2O$ is usually white to yellowish white in color and is found as a compact mass.

APPLICATION IN DENTISTRY:

1. Impression material



2. Casts and dies

Dr. Mohammed T. AL-Khafagy

APPLICATION IN DENTISTRY:

3. **Mounting to the articulator**

4. Molds for processing dental polymers

5 .Gypsum -bonded investment

PROPERTIES OF *IDEAL* MODEL MATERIAL:

1. **Dimensional stability, no expansion or contraction during or after setting.**

2. **High compressive strength to withstand the force applied on it.**

3. **Hardness.**

4. **Reproduce the fine details.**

PROPERTIES OF *IDEAL* MODEL MATERIAL:

5. Produce smooth surface

6. Reasonable setting time

7. Compatible with the impression materials

8. Can be disinfected without damaging the surface

TYPES:

1. Type I: impression plaster

2. Type II: plaster

3. Type III: stone

4. Type IV: high strength low expansion stone (die stone).

5. Type V: high strength high expansion stone.

METHODS OF PRODUCTION

PLASTER

$$CaSO_4 2H_2O \xrightarrow[-1\frac{1}{2}H_2O]{120C \text{ in air}} CaSO_4 \frac{1}{2}H_2O$$

METHODS OF PRODUCTION

stone

$$CaSO_4 2H_2O \xrightarrow[-1\frac{1}{2}H_2O]{120C \text{ in autoclave}} CaSO_4 \frac{1}{2}H_2O$$

METHODS OF PRODUCTION

Die stone

$$CaSO_4 2H_2O \xrightarrow[-1\frac{1}{2}H_2O]{\text{boiling with 30\% } CaCl_2} CaSO_4 \frac{1}{2}H_2O$$

SETTING REACTION

$CaSO_4.1/2H_2O + H_2O$

$CaSO_4.2H_2O + HEAT$

Prof. Dr. Mohammed AL-Khafagy

The setting is accompanied by the following effects:

a) Evolution of heat (exothermic reaction)

b)Development of strength (interpenetration of crystallites)

c) Setting expansion

MANIPULATION

W/P ratio for plaster is 0.5 (that is 50 ml of water for 100 gm of plaster powder).

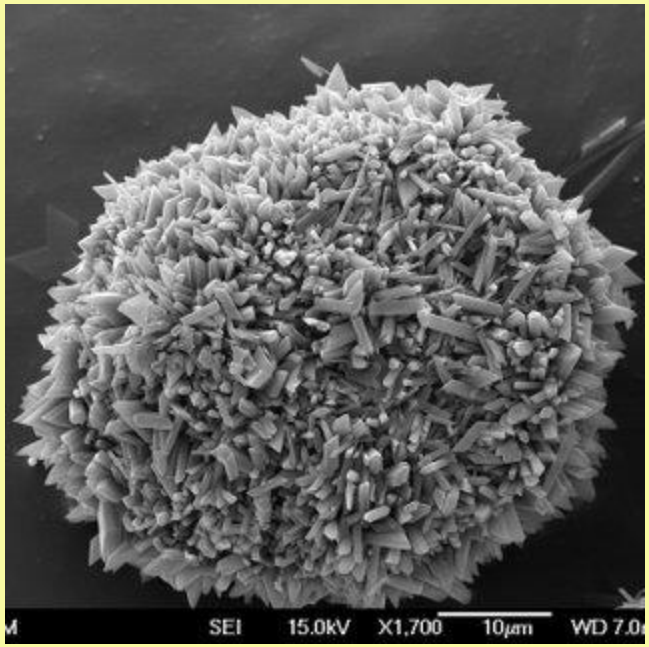
W/P ratio for stone is 0.3

W/P ratio for die stone is 0.2

MANIPULATION

Initial set and Final set

The crystallization of $CaSO_4.2H_2O$ from the saturated solution requires a mechanism of *NUCLEATION*



Prof. Dr. Mohammed AL-Khafagy

Initial set and Final set

These times are measured by the ability of the setting plaster (or stone) to withstand a stress.

Initial set and Final set

GILLMORE NEEDLES

Prof. Dr. Mohammed AL-Khafagy

Initial set and Final set

Automatic recording Vicat apparatus.

Prof. Dr. Mohammed AL-Khafagy

Initial set and Final set

GILLMORE NEEDLES

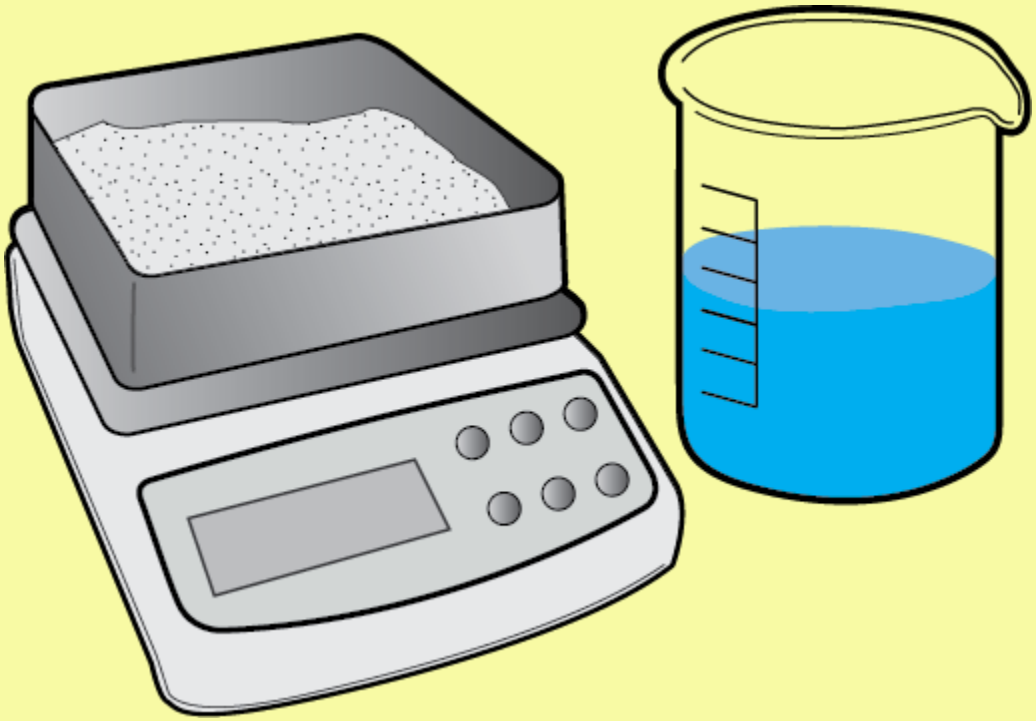
0.3 MPa → **Initial set**

5 MPa → **Final set**

FACTORS EFFECTING THE SETTING TIME

1. w/p ratio

The more water is used for mixing, the fewer nuclei there will be per unit volume, and consequently the setting will be prolonged.



Prof. Dr. Mohammed AL-Khafagy

FACTORS EFFECTING THE SETTING TIME

2. Fineness

The finer the particle size of the hemihydrate, the faster the mix will harden.

3. Mixing

The longer and the more rapidly the plaster is mixed, the shorter is the setting time.

FACTORS EFFECTING THE SETTING TIME

4. Temperature

- There is little change in the setting time between 0-50C ***but if the temp.***
- Exceeds 50C, the setting time will be retarded.
- As the temp approaches 100 C, no setting will take place .

FACTORS EFFECTING THE SETTING TIME

5. Impurities

If the manufactures add gypsum, the setting time will be shortened because of the increase in the potential nuclei for crystallization

6. Retarders and Accelerators

The addition of accelerators and retards are the most effective and practical for the control of the setting time.

- **Retarder:** is the chemical material added to the gypsum product to increase the setting time, ex. ***Glue borax, and gum arabic.***
- It will reduce the dissolution of the hemihydrate and might deposit on the nuclei of crystallization and effectively reduce the rate of crystallization so retard the setting time.

- **Accelerator:** is the chemical material added to the gypsum product powder to decrease the setting time, ex. ***sodium chloride and potassium sulfate in certain concentration.***
- These salts increase the rate of dissolution the hemihydrate and thus the saturation of the solution occur more rapidly and the gypsum formation.

DIMENTIONAL CHANGES ON SETTING (SETTING EXPANSION)

There is an outward growth of crystals from nuclei of crystallization, as a result of the growth, there is an enlargement and there is interception between the crystals.

Factors affecting the setting expansion

1. w/p ratio

The **higher** the w/p ratio, the **less** the expansion because of fewer nuclei of crystallization per unit volume are present

2. Addition of chemicals (accelerators and retarders)

Both will **reduce** the setting expansion.

Factors affecting the strength

1. w/p ratio

2. Mixing

3. Drying

4. Chemicals

5. Porosity

STORAGE

- Plaster and stone powder absorbs moisture.
- Hydration begins on the, surface of the hemihydrate particles forming fine coat of gypsum and this will act as effective nuclei for crystallization and this shortens the setting time.
- To avoid deterioration, plaster and stone powders should be stored in **airtight waterproof containers in a dry region of the laboratory.**

General properties

Material w/p	compressive strength*	Rockwell hardness	expansion
Plaster 0.5	98-140	15	0.3%
Stone 0.3	210-280	66	0.2%
Die stone 0.2	350	80	0.l%

*kg/cm

Any Question?