Lec. 3

Dental Materials

Gypsum Materials

A number of gypsum products are used in dentistry as adjuncts to dental operation. Various types of gypsum products are used to form molds and casts on which dental prosthesis and restorations are constructed.

Application in Dentistry:

- **1.** Impression material.
- 2. Casts and dies.
- **3.** Mounting to the articulator.
- 4. Molds for processing dental polymers.
- **5.** Gypsum- bonded investment.

Dental Models

Three-dimensional reproductions of the teeth and the surrounding soft tissue of a patient's maxillary and mandibular arches. Also referred to as study casts.

<u>*Cast:*</u> positive replica of <u>teeth</u> and/or the associated supporting soft and hard tissues of the jaw, prepared from an impression.

<u>Die</u>: is a model of a <u>single tooth</u>, also prepared from an impression.

Properties of Ideal Model Materials

- **1.** Dimensional stability, no expansion or contraction during or after setting.
- 2. High compressive strength to withstand the force applied on it.
- 3. Hardness, soft material can easily scratch.
- 4. Reproduce the fine details.

- 5. Produce smooth surface.
- 6. Reasonable setting time.
- 7. Compatible with impression materials.
- 8. Can be disinfected without damaging the surface.
- 9. Good color contrast / Ease of use / Cheap.

Types:

- 1. Type I: Impression Plaster.
- 2. Type II: Plaster.
- **3. Type III:** Stone.
- 4. Type IV: Die Stone.
- 5. Type V: High Strength High Expansion Stone.

Methods of Production:

Gypsum products are produced by partially dehydration of mineral gypsum which is Calcium Sulfate Di-hydrate (CaSO4.2H2O, CSD). They are supplied as powder when mixed with water they form slurry or paste, which set to form a rigid mass.

Plaster: when the gypsum is heated in an open container to 110-120C°, it gives part of its water to form plaster (CaSO4.¹/₂H2O, CSH). The crystals are irregular in shape, porous and called Beta particles.

Stone: chemically it is the same as plaster, but it is made by heating gypsum in wet condition under super heat steam to 125C°. The crystals are regular in shape, have prismatic shape and called Alpha particles.

Die Stone: it is produced by boiling gypsum with 30% calcium chloride (CaCl2). The crystals are dense, regular in shape, have prismatic shape and called Alpha particles.



	PLASTER	STONE	DIE STONE
Chemical Name: β -calcium sulfate		lpha-calcium sulfate	lpha-calcium sulfate
Formula:	CaSO4-(1/2) H2O	CaSO4-(1/2) H2O	CaSO4-(1/2) H2O
Powder Shape:	: Irregular	Uniform	Uniform
Density:	Porous45%	Moderately Dense15%	Dense10%
Production Steps : Heat to 120C ⁰		Heats to 125C ^o	Heats to 100C ^o
	In air	with steam pressure	In CaCl2

So basic ingredients of plaster dental stone and die stone is the calcium sulfate hemihydrate but the main difference is in shape, size, porosity of the crystals which produce a different physical properties and makes each of them usable for different purposes in dentistry.

Setting Reaction

When mixing any type of gypsum products with water, they are converted back to gypsum and set to hard mass. The difference in the solubility between the CSH and CSD cause the setting of the material. The probable sequence is as follow:

- **1.** Plaster or Stone or Die Stone (CSH) dissolves in water, giving Ca++ and SO4- ions.
- 2. It reacts with water to form gypsum (CSD).
- **3.** Gypsum is less soluble in water; the solution becomes super-saturated (unstable condition).

4. Gypsum crystallizes, allowing more particles to dissolve and to form gypsum. This will continue until all the particles have been converted to gypsum (CSD). Each crystal as it forms becomes nucleus for crystallization. During this process part of the gypsum form a gel, this acts as a cementing medium between the crystals. Then the rigid mass is formed by the interlocking network formed by the long needle- like gypsum crystals.

Manipulation

The powder is mixed with water at certain ratio according to the type of gypsum product.

W/P ratio for Plaster = 0.5 (50 ml water for 100 gm plaster powder) W/P ratio for Stone = 0.3

W/P ratio for Die Stone = 0.2

The difference in W/P ratio is due to the difference in the bulk volume of the powders. The water is measured and put in a clean rubber bowel then the powder is stiffed on it gradually, allow the powder to settle then mix with clean spatula for 1 min. until creamy mix is obtained.