CHAPTER 1

GYPSUM
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• Rock formation in nature, $\text{CaSO}_4(2\text{H}_2\text{O})$.
• It is hydrous calcium sulfate with compounds of lime, sulfur and water.

2.1 Production of Gypsum:
• Gypsum contains clay, limestone, silica, iron compound, etc.

• In the pure state it is white, but combined with impurities, it may be grey, brown, or reddish brown.

• Some deposits are found close to the surface of the earth; others well below the surface.

• A valuable building material for several thousand years.
CaSO$_4$ 79.1%  
CaO 32.5%  

CaSO$_4$(2H$_2$O)  

SO$_3$ 46.6%  
H$_2$O 20.9%  

Where;
CaSO$_4$ : Calcium sulfate
CaO : Lime
SO$_3$ : Sulfur trioxide
H$_2$O : Water
Natural deposits of gypsum rock are seldom pure.
Usual impurities: SiO$_2$, Al$_2$O$_3$, Fe$_2$O$_3$, MgO, CaCO$_3$, MgCO$_3$, ....etc.
• A suitable gypsum rock must contain at least 70% CaSO$_4$.2H$_2$O (hydrous calcium sulfate).

• The obtained gypsum stones first are crushed into 50-75 mm in diameter, then ground and then calcined.

• During calcinations it drives off 75% of the combined water under the temperature of 190°C.
<table>
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<th>Reaction of gypsum:</th>
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<td>(100-190)°C</td>
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1- $\text{CaSO}_4 \cdot 2\text{H}_2\text{O} \; \Rightarrow \; \text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O} + 1\frac{1}{2}\text{H}_2\text{O}$ (partial dehydration) |

$\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$ : Plaster of Paris (Hemihydrate) |

2- $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O} \; \Rightarrow \; \text{CaSO}_4 + 2\text{H}_2\text{O}$ (complete dehydration) $T>190°C$ |

$\text{CaSO}_4$ : Anhydrate (anhydrous gypsum)
Hardening of Gypsum:

\[
\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O} + \frac{1}{2}\text{H}_2\text{O} \quad \longrightarrow \quad \text{CaSO}_4 \cdot 2\text{H}_2\text{O}
\]

\[
\text{CaSO}_4 + 2\text{H}_2\text{O} \quad \longrightarrow \quad \text{CaSO}_4 \cdot 2\text{H}_2\text{O}
\]

Pure gypsum sets in about 10 minutes. Impure plasters set more slowly.

**Retarders (maximum 2%)**: Glue, saw dust, blood, organic substances, borax and acetic acid.

**Accelerators**: Common salt, alum, sodium
Plasticity:
To increase plasticity of gypsum plaster 15% hydrated lime or less frequently 15% clay should be added.

The compressive stress of gypsum is larger than tensile stress.

As the ratio of mixing (water / gypsum) increase, its stress decreases.
1.3 Properties of Gypsum:

• Gypsum often serves as a fireproofing material although its strength is destroyed by continuous heat.
• Gypsum is an effective material in delaying the passing of fire from a room to another.
• Gypsum plasters tend to disintegrate when exposed to moisture. Therefore, they should not be used for exterior work or moist interior location.