Lime

1- Definition and classification:

1.1- Quick lime:

Is the name applied to the commercial form of calcium oxide CaO, obtained by the calcinations of a stone in which the predominating constituent is calcium carbonate $CaCO_3$, often replaced, to a greater or less degree by magnesium carbonate $MgCO_3$, this product being one that will slake on the addition of water.

1.2- Hydrated lime:

Is quick lime has been chemically satisfied with water during manufacture.

2- Raw materials – Lime stone rocks:

Pure lime stone rocks consist entirely of $CaCO_3$. Pure calcium carbonate consists of 56 parts by weight of CaO to 44 parts of CO_2.

Lime stones encountered in practice depart more or less from this theoretical composition. Part of the lime is almost always replaced by a certain percentage of magnesia MgO. In addition to magnesia, silica, iron, oxide and alumina are usually present and too slight extent, sulfur and alkalies.

The physical character of the lime stone has an effect upon the burning temperature. A naturally, coarse, porous stone is acted upon by heat much more rapidly than a dense, finely crystalline stone, and may be burned more rapidly and at a lower temperature.

3- Manufacture of lime – Theory of calcinations:

The burning or calcinations of lime accomplishes three objects:

a. The water in the stone is evaporated.

b. The lime stone is heated to the request temperature for chemical dissociation.

c. The CO_2 is driven off as a gas, leaving the oxides of calcium and magnesium.

4- Uses of quick lime:

Lime may be used as:

a.Building materials.

b.Finishing materials.

5- Properties of quick lime:

5.1- Plasticity:

The term " plasticity " is commonly used to describe the spreading quality of the material of the material in plastering. If it spreads easily and smoothly, it is plastic, if it sticks under the trowel, or cracks, and drops behind the trowel, it is non plastic.

5.2- Sand- carrying capacity:

Practically all lime used structurally is made up in the form of mortar by the addition of sand to lime paste for the following reasons:

a. Sand is cheaper than lime.

b. To diminish the great shrinkage which accompanies the setting and hardening of lime, and to prevent the consequent cracking.

c. To counteract the extreme stickiness' of some high- calcium limes.

It is important that the "sand- carrying capacity" of the lime be properly established. If too little sand is used, excessive shrinkage will cause a weakening of bond between the plaster or mortar and the masonry materials or plastered surface. On the other hand, too much sand produces a non-plastic and weak mortar.

5.3- Setting time:

The setting of lime and lime mortar is a chemical process involving the evaporation of the large excess of water used in forming the lime paste, followed by the gradual replacement of the water of hydroxide by CO_2 in the atmosphere, causing the lime hydrate to revert to the original calcium carbonate.

$$CaO + H_2O \rightarrow Ca(OH)_2$$

$$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$$

5.4- Tensile and compressive strength of lime mortars:

The physical properties of lime mortar vary with the:

a. Chemical composition of the lime: Magnesia lime makes it stronger than calcium limes.

b. Character of the sand: Fine sand makes stronger mortar than coarse sand.

c. The amount of water: Suitable amount of water produces stronger lime mortar.

d. The conditions under which the mortar sets: The humidity and amount of CO_2 in the atmosphere influence the rate of setting of lime drying the air and charging it with carbon dioxide, greatly accelerating the setting process.

6- Hydrated lime:

6.1- Process of manufacture:

Hydrated lime is a dry powder resulting from the hydration, at the place of manufacture, of ordinary quick lime. Three stages of manufacture characterize the preparation of hydrated lime:

a. The quick lime is crushed or pulverized to a fairly small size.

b. The crushed materials are thoroughly mixed with a sufficient quantity of water.

c. The slaked lime is, by air separation, screening, or other wise separated from lumps of anhydrate lime and impurities, or the entire mass must be finely pulverized.

6.2- Uses:

Hydrated lime may be used as:

a. Building materials.

b. Finishing materials.

6.3- Properties:

a. Mortar prepared from hydrated lime is generally inferior to those prepared from quick lime from the stand point of plasticity and sand – carrying capacity.

b. The strength of hydrated lime mortars, both in tension and in compression, is somewhat higher than that of the corresponding quick lime mortars.

c. Hydrated lime mortars are more quickly setting than from ordinary quick lime mortars.