

## Harmful Ingredients in Clay Bricks.

**1- lime:** Excess of lime makes the colour of the brick yellow instead of red. Limps of limestone remaining in the finished brick are undesirable because, when such a brick comes in contact with water, lime will begin to slake. During slaking, lime expands and also generates heat. Due to this, stresses will be produced, which will result in producing cracks in bricks. A certain quantity of lime is desirable as it binds the particles of brick together and reduces shrinkage on drying.

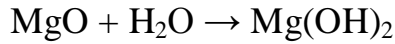
**2. Iron pyrites:** tend to oxidize and decompose the brick during burning. The brick may split into pieces. Pyrites discolourise the bricks.

**3. Pebbles:** The presence of pebbles, grit, gravel etc. will be undesirable because they prevent the clay from being mixed well. They spoil the manufacture of smooth and regular, standard bricks. Pebbles, gravel, grit, etc., should be removed before mixing.

**4. Organic matter:** This includes leaves, twigs of plants, roots, grass, bones of animals etc. On burning green bricks, the organic matter gets charred and leaves porous making the bricks porous (this is due to the fact that the gasses will be evolved during the burning of the carbonaceous matter and it will result in the formation of small porous).

**5. Alkalis ( $MgO$ ,  $K_2O$ ):** If alkalis are present in the clay brick, they lower the fusion point of clays and cause the brick to fuse, twist and warp during burning. Alkali salts if present in finished bricks absorb moisture from the atmosphere and create damp condition which are detrimental to health. Further when the moisture dries up a grayish white deposit is left

behind which spoil the appearance of the structure, the effect being known as efflorescence.



**6. Salts:** It is usually found in clay as the sulphate of calcium, magnesium, sodium, potassium or iron, or as iron sulphide. Generally, the proportion is small. It however, there is carbon in the clay and insufficient time is given during burning for proper oxidation of carbon and sulphur, the latter will cause the formation of a spongy, swollen structure in the brick and the brick will be decoloured by white blotches.

## **Sand-Lime Bricks**

The manufacture of building bricks from mixtures of sand and lime began more than half a century ago, but the modern methods of manufacture are of much more recent origin. The first bricks prepared from sand and lime have been properly called mortar bricks,” for in reality they consisted of nothing more than common lime mortar molded into bricks and allowed to harden by the absorption of carbonic acid from the atmosphere. In this process it was necessary to use enough lime to surround the sand grains and give a more or less plastic mortar which could be molded in a manner similar to the soft-mud process for making clay brick. The amount of lime used varied from 20 to 40 per cent, depending on its quality. The hardening was due to the formation of calcium carbonate, and, when finished, the bricks consisted of grains of sand embedded in a sort of artificial limestone. The sand served the purpose of preventing the brick from shrinking on drying, and at the same

time, it reduced the amount of lime required in the mixture. The objections to "mortar bricks" are obvious, and it is not surprising that the bricks were used only in regions where the soil was sandy, and clays for making other kinds of bricks could not be found. Moreover, the large percentage of lime required in their manufacture and the long time necessary for hardening them, especially in wet seasons, made them too costly to compete with common bricks.

In 1881 Dr. W. Michaels took out a patent for hardening mixtures of lime and sand by high pressure steam. In 1896 there were in Germany several plants in operation using the process patented by Dr. Michaels, but it was not until the year 1898 that sand-lime bricks were produced on a large scale. Sand-lime brick may be defined as a mass of sand grains cemented together by hydrated calcium silicate. If the lime used, in the manufacture is dolomitic there will be in the bond hydrated magnesium silicate as well as calcium silicate, but experience has shown that the best product is obtained when the percentage of magnesium oxide in the lime is low. The reaction between lime and silica resulting in the formation of hydrated lime silicates takes place slowly at ordinary temperatures in moist atmospheres, but in practice it is hastened by the action of steam.

## **Raw Materials**

The raw materials required for manufacture of sand-lime bricks are as follow:

**1- Sand:** the sand in sand-lime brick should meet the physical and chemical requirements of Iraqi standard No. 572.

a) Contain not less than 70% silica.

- b) Well graded between 0.005-0.5 mm.
- c) Free from impurities such as organic matter, rock, minerals and soluble salts.
- d) The percentage of clay not more than 10%.
- e) iron compounds not more than 1.5%.
- f) Gypsum content not more than 1%.
- g) ( CaO + MgO ) not more than 5%.

**2. Lime :** the lime used in sand-lime brick should meet the requirements of Iraqi standard No. 572

- a) Activity of lime shall not be less than 83%.
- b) The percentage of lime retaining on 75 pm sieves should not be greater than 2%.

**3. Water :** water used in sand lime brick should be fit for drinking.

**4. Pigment:** To make colored sand lime bricks, suitable coloring pigment should be added in the mixture of sand and lime. The quantity of pigment varies from 0.2 to 3% of the total weight of the brick.

## **Manufactures:**

Sand-lime bricks are made from a lean mixture of slaked lime and fine siliceous sand, molded under mechanical pressure and hardened under steam pressure. Constituents of these bricks are sand, lime, water and coloring pigment. They consist of 88 to 92% of sand, 8 to 12% of lime and 0.2 to 0.3% pigments. Water containing soluble salts or organic

matter more than 0.25% should not be used in the manufacture of these bricks. Sea water is totally unfit.

Generally the lime is slaked before mixing with the sand by placing it beneath the brick cars in the hardening cylinder and allowing the steam to act upon it. Often the sand and lime are mixed dry in a tube mill and the mixture is then tempered in a special type of pug mill. In some plants the quick lime is slaked.

Sand, lime and pigment are taken in appropriate proportion and mixed with 3% to 5% of water, so that the mixture acquires a state of semi-dry condition. The material is then molded in form of bricks. Molding is done in powerful presses, some of which can exert a compression of 30 to 60 N/mm<sup>2</sup> on the surface of the brick. After removal from the press the bricks are stacked on cars which are run into the hardening cylinders. The bricks thus prepared do not require any drying. The prepared bricks are directly fed into an autoclave and subjected to a saturated steam pressure of about 8 to 16 kg/cm<sup>2</sup>. This pressure is maintained for 6 to 12 hours. During, autoclaving operation, interaction between lime and sand takes place and both combine chemically. The bricks are now removed From the autoclave and sent for use. These bricks do not require burning as well as drying. The process of subjecting these bricks to a saturated steam. pressure is known as autoclaving or hydrothermal treatment.

$\text{CaO} + \text{H}_2\text{O} + \text{SiO}_2 \rightarrow \text{CaO}.\text{SiO}_2.\text{H}_2\text{O}$  "Tobermorite""Hydrous calcium silicate"

$\text{Ca}(\text{OH})_2 + \text{CO}_2 \rightarrow \text{CaCO}_3 + \text{H}_2\text{O}$

## **Advantage:**

- 1- They are quite hard and strong.
- 2- They are uniform in color and texture.
- 3- The raw materials used do not contain any soluble salts and these bricks are free from efflorescence.
- 4- Being very uniform in size, their masonry work requires a very thin layer of plaster.
- 5- These bricks present such a pleasing appearance, that plastering may be avoided.
- 6- Sand lime bricks are used for ornamental work.

## **Disadvantage:**

- 1- They are unsuitable for furnaces since they disintegrate, when subjected to prolonged hot conditions.
- 2- They are very weak against abrasive action and hence cannot be used for paving.
- 3- Being less resistant against water, they are found unsuitable for use in foundations.

## **Comparison of Clay and Sand-Lime**

On account of their smooth surfaces, even shape, free from efflorescence, uniform color and satisfactory strength. Sand-lime bricks are sometimes preferred to clay bricks. Some of the sand-lime bricks, however, have not been as durable when exposed to the weather as good grades of clay brick. Unless made with great care sand-lime bricks do not resist frost action.