Introduction:-

Building materials have an important role to play in this modern age of engineering. The building materials industry is an important in our national economy as its output governs both the rate and quality of construction work. There are factors which affect the choice of building materials:

1. Type and function of the building or structure and the specific characteristics required of the materials used, i.e. great strength, water resistance, wear resistance, attractive appearance, etc.
2. Economic aspects of the building/structure in terms of original investment and annual cost of maintenance.
3. Availability of materials in the area.
4. Availability of the skilled labor required to install some types of material.
5. Quality and durability of different types of material.
6. Transportation costs.
7. Selection of materials with compatible properties, dimensions and means of installation.
8. Cultural acceptability or personal preference.

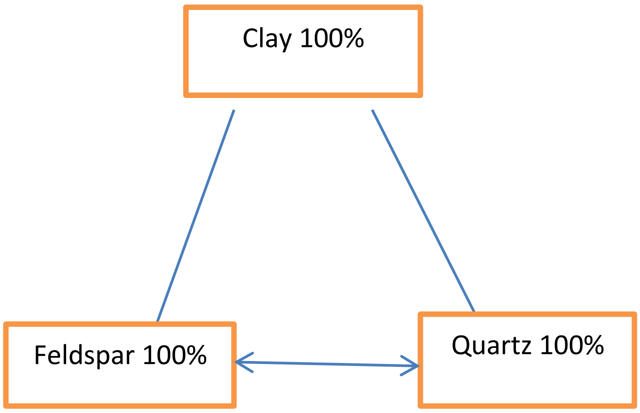
Bases of their chemical makeup and atomic structure as metal, ceramic, polymer or composite between these materials.

The most building materials are produced from ceramic materials such as structural clay products (clay bricks, clay tiles, clay pipes, glazed clay products, lime-sand bricks and gypsite bodies) and cement.

Building Materials Processing:-

1-Raw Materials

The essential ceramic materials are three and build triangle.



1- Clays:-

Clays imply the plasticity to the ceramic materials to improve the forming process.

The clays are the widest applications of ceramic raw materials. They are fine particles hydrous aluminum silicate. The hydrated silicates of aluminum are clay substance, which give the clays there main defined characteristics. One of the predominant properties of these substances is the extreme fineness of their particles. Basically the structure of this clay mineral is dominated by the distribution of the largest atoms, namely oxygen. The simplest clay mineral is kaolinite.

Formation of clay:

Clay minerals typically form over long periods of time as a result of the gradual chemical weathering of rocks, usually silicate-bearing, by low concentrations of carbonic acid and other diluted solvents. These solvents, usually acidic, migrate through the weathering rock after leaching through upper weathered layers. In addition to the weathering process, some clay minerals are formed through hydrothermal activity. There are two types of clay deposits: primary and secondary. Primary clays form as residual deposits in soil and remain at the site of formation. Secondary clays are clays that have been transported from their original location by water erosion and deposited in a new sedimentary deposit. Clay deposits are typically associated with very low energy depositional environments such as large lakes and marine basins.

Clay as a building material:

Clay is one of the oldest building materials on Earth, among other ancient, naturally-occurring geologic materials such as stone and organic materials like wood. Between one-half and two-thirds of the world's population, in both traditional societies as well as developed countries, still live or work in buildings made with clay, often baked into brick, as an essential part of its load-bearing structure. Also a primary ingredient in many natural building techniques, clay is used to create adobe, , and rammed earth structures and building elements such as wattle and daub, clay plaster, clay render case, clay floors and clay paints and ceramic building material. Clay was used as a mortar in brick chimneys and stone walls where protected from water.

Clay minerals

Clay minerals are hydrous aluminum phyllosilicates, sometimes with variable amounts of iron, magnesium, alkali metals, alkaline earths, and other cations found on or near some planetary surfaces.

Clay minerals form in the presence of water and have been important to life, and many theories of abiogenesis involve them. They are important constituents of soils, and have been useful to humans since ancient times in agriculture and manufacturing.

Structure of Clay:

Like all phyllosilicates, clay minerals are characterized by two-dimensional sheets of corner sharing SiO_4 tetrahedral and/or AlO_4 octahedral. The sheet units have the chemical composition $(Al,Si)_3O_4$. Each silica tetrahedron shares 3 of its vertex oxygen atoms with other tetrahedral form a hexagonal array in two-dimensions. The fourth vertex is not shared with another tetrahedron and all of the tetrahedral "point" in the same direction; i.e. all of the unshared vertices are on the same side of the sheet.

In clays, the tetrahedral sheets are always bonded to octahedral sheets formed from small cations, such as aluminum or magnesium, and coordinated by six oxygen atoms. The unshared vertex from the tetrahedral sheet also forms part of one side of the octahedral sheet, but an additional oxygen atom is located above the gap in the tetrahedral sheet at the center of the six tetrahedral. This oxygen atom is bonded to a hydrogen atom forming an OH group in the clay structure. Clays can be categorized depending on the way that tetrahedral and octahedral sheets are packaged into *layers*. If there is only one tetrahedral and one octahedral group in each layer the clay is known as 1:1 clay. The alternative, known as 2:1 clay, has two tetrahedral sheets with the unshared vertex of each sheet pointing towards each other and forming each side of the octahedral sheet.

Bonding between the tetrahedral and octahedral sheets requires that the tetrahedral sheet becomes corrugated or twisted; causing tetragonal distortion to the hexagonal array, and the octahedral sheet is flattened. This minimizes the overall bond-valence distortions of the crystallite.

Depending on the composition of the tetrahedral and octahedral sheets, the layer will have no charge, or will have a net negative charge. If the layers are charged this charge is balanced by interlayer cations such as Na^+ or K^+. In each case the interlayer can also contain water. The crystal structure is formed from a stack of layers interspaced with the interlayers.

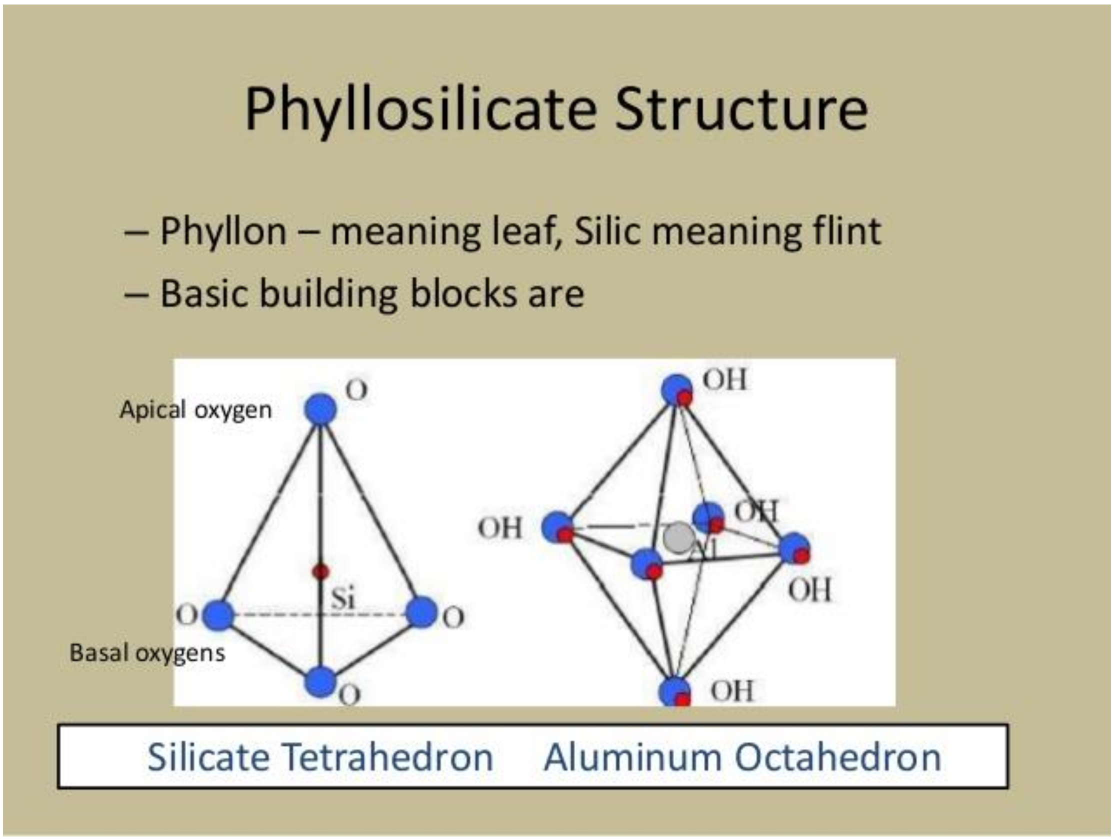


Fig.(1)

applications of Clay Products:

Universal availability of raw materials, comparative simplicity of manufacture and excellent durability of ceramic materials has put them in the forefront among other constructional materials. The high strength and durability of clay products underlie their wide use in the various elements of buildings, such as walls, wall and floor facing materials, lining materials for chemical industry apparatus, chimney, light porous aggregates for roofing, and sewer pipes. The various applications of clay products in the building industry are as follows:

1. Wall materials. The examples are common clay brick, perforated clay brick, porous and perforated stiff-mud brick, and hollow clay dry-press brick. Perforated plastic molded ceramic stones and light weight building brick. Clay brick accounts for half of the total output of wall materials. Structural properties of hollow clay products and low heat losses through Air-filled voids (particularly at subzero temperatures) provide great possibilities for reducing the thickness and the weight of exterior walls. Ceramic facing tiles remain the chief finishing material for sanitary and many other purposes and are still in great use for external facing of buildings.

2. Brick for special purposes. The example is curved clay brick, stones

For sewage Installations (underground sewer pipes) brick for road surface (clinker).

3. Hollow clay products for floors. The examples are stones for close-ribbed floors.

(Prefabricated or monolithic), stones for reinforced ceramic beams, sub flooring stones (fillers between beams).

4. Facade decoration. The examples are glazed or non-glazed varieties subdivided in to facing brick and ceramic stones, floor ceramics, small-size ceramic tiles, ceramic plates for facades and window-sill drip stones.

5. Clay products for interior decoration. The examples are tiles for facing walls, built-in parts, large floor tiles and mosaic floor tiles.

6. Roof materials. The examples are common clay roof tiles for covering slopes of roofs, ridge tiles for covering ridges and ribs, valley tiles for covering valleys, end tiles ("halves" and "jambs") for closing row of tiles, special tiles.

7. Acid-resistant lining items. The examples are common acid-resistant brick, acid-resistant and heat-and-acid-resistant ceramic shaped tiles for special purposes, ceramic acid-resistant pipes and companion shapes.

8. Sanitary clay items. Sanitary wares items are manufactured mainly form white-burning refractory clay, kaolin's, quartz and feldspar. There are three groups of sanitary ceramics: faience, semi-porcelain and porcelain, which differ in degree of caking and, as a consequence, in porosity. Items from faience have a porous shell, and items from porcelain, a solid shell, while those from semi-porcelain are of intermediate densities. The various degrees of caking of faience, porcelain and semi-porcelain, made of the same raw materials, are due to the latter's different proportions in the working mass. Solid faience is used mainly to manufacture toilet bowls, wash basins, toilet tanks and bath tubs. Items are glazed, since unglazed faience is water permeable. Semi-porcelain items feature excellent hygienic and mechanical properties being intermediate between those of faience and porcelain. Porcelain outer shell is impervious to water and gases and possesses high mechanical strength and resistance to heat and chemical agent. Porcelain is used to manufacture insulators for power transmission lines, chemical laboratory vessels, etc.

9. Aggregate for concrete. Creamiest (manufactured from low-heat clay), a light weight porous material forms excellent aggregate for light weight concrete.