Zircon → $ZrSiO_4$, Willemite → Zn_2SiO_4

garnet → $Ca_3Cr_2(SiO_4)_3$

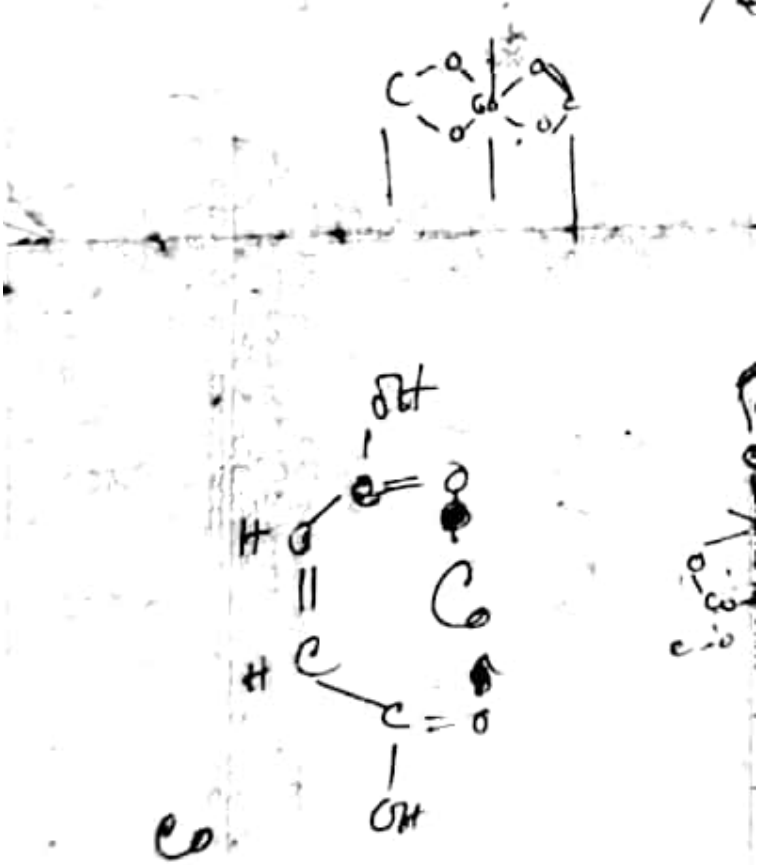
emerald → $Be_3Al_2(SiO_3)_6$

adiopside → $CaMg(SiO_3)_2$

tale → $Mg_3(OH)_2Si_4O_{10}$

Hemimorphite → $[Zn_2(OH)_2Si_2O_7 \cdot H_2O]$

Thortveitite → $[Sc_2Si_2O_7]$



Dent: a slight hollow in a hard even surface by a blow or pressure

→ coloured due to Fe.

Sand is mostly SiO_2. Naturally occurring sand is

Sand: A mineral resulting from rock disintegration

Tripotali: A type of bond.

Feldspar: A group of aluminosilicates containing one or more of the following base: potash (K_2O), soda (Na_2O), lime, barium oxide.
Used in the ceramic and enamellic industries

Chalk: A naturally occurring variety of $CaCO_3$ formed by marine organism.
Black board chalk is $CaSO_4$

Quartz: A naturally occurring [illegible]

Industrial Chemistry. Chapter-9, P-"366-378"
B. K. Sharma

CHEMISTRY OF SILICATES.

DEFINITION: (Dictionary - Rita Kaushik & M. S. Yadav)

The compounds containing metal ions and complex silicon oxygen compounds are known as silicates. The negative ions in silicates are of the type SiO_4^{4-}, $Si_2O_7^{6-}$ $(Si_3O_9)^{6-}$ etc. containing SiO_4 units linked in long chain sheets or three dimentional arrays. e.g. Aluminosilicates and Borosilicates contain Al or B atoms in the structure.

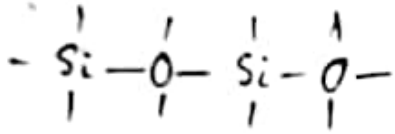
PROPERTY

The properties of most typical silicates result from the specific structure of their molecules, the basic structural element being SiO_4^{4-} group. The most important feature of this group or structure is the high strength of the bond between Si^{4+} and O^{2-} ions, because of most silicates are extremely hard and have a high melting point. Some other common properties of most silicates are

(a) Chemical stability due to chemical inertness.
(b) Resistance to high temperature.
(c) Comperatively low cost, because of availability of the raw materials.
(d) Most of the silicates are soluble in hydrofluoric acid.

STRUCTURE OF SILICATES: (B.K Sharma – 10 343)

Silicon (14) forms a strong bond with oxygen (bond energy Si–O = 88 kcal per mole) which in turn can bond to another silicon forming a chain of the type.



These chains link link together to form a macromolecule as shown in fig. 1

$Si(14) = 1s^2 2s^2 2p^6 3s^2 3p^{1v} \equiv 1s^2 2s^2 2p^6 3s^1 3p_x^1 3p_y^1 3p_z^1 = sp^3$

$O(8) = 1s^2 2s^2 2p^4 \equiv 1s^2 2s^2 2p_x^2 2p_y^1 2p_z^1$

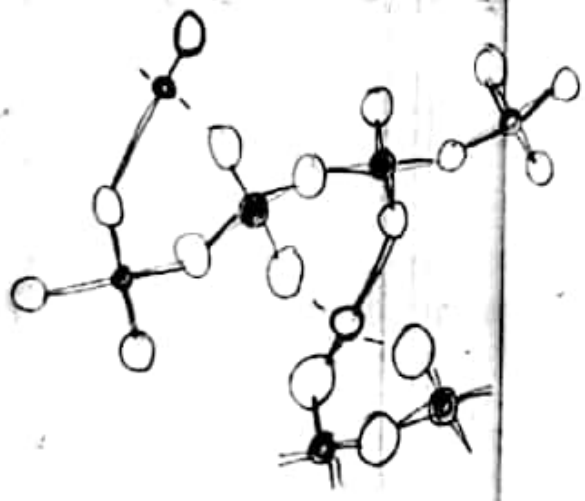
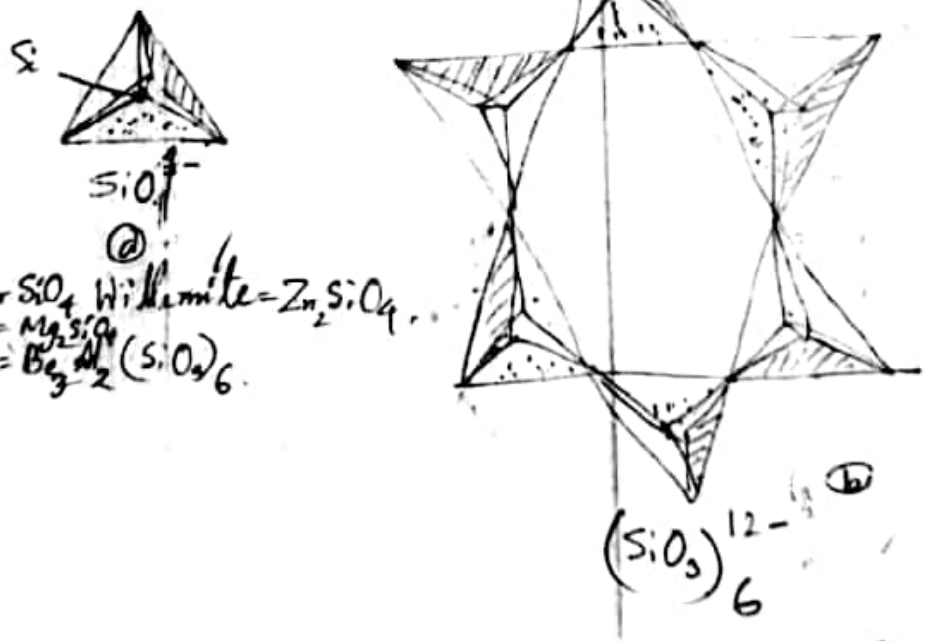


Fig-1. Crystal structure of quartz (SiO_2)

In the crystal, each silicon atom is at the centre of tetrahedron, bonded to four oxygen atoms, each oxygen atom being linked with two silicon atoms.

SiO_2 is the most common form of silica
the main component of sea sand.
orientation of the oxygen atoms in the
ot unique there are more than 20 crysta-
eations of SiO_2, which differ in the
which the atoms are actually packed
stals. Quartz like graphite and diamond
melting point at about 1700°C. Unlike
s it however does not melt sharply
but burns to a viscous mass. At
t about 1400°C. The viscous

X-ray diffraction studies have confirmed that in silicate each silicon atom is bonded to four oxygen atoms tetrahedrally because of sp^3 hybridization. The sp^3 hybridized orbitals form four covalent bonds with the oxygen atoms to form a regular tetrahedron in which oxygen atoms are arranged around the central silicon atoms, with the bond angle of 109°28' each. From the structural point of view, the simplest silicates are those containing discrete silicate organions. (Fig-2).



...con = $Zr SiO_4$ Willemite = Zn_2SiO_4.
...tesite = Mg_2SiO_4
...erald = $Be_3Al_2(SiO_3)_6$

Fig: Two silicate anions. In solids containing these ions the cations are arranged in voids in the oxygen atoms lattices.

INDUSTRIAL CHEMISTRY INCLUDING CHEMICAL ENGINEERING
BY. B K. SHARMA · P - 10-366

* CERAMICS ∋ it is very difficult to give the proper definition of ceramics. Normally articles are given the term ceramics and produced from different types of silicates especially from clay by forming a casting followed by drying and firing to the sintering point.

According the their main field of use ceramic materials and ware can be divided into the following basic groups.

① Structural ceramics: Articles used mainly in the construction of buildings and various structures are called structural ceramics eg. Building brick such as common brick or hollow tile brick blocks, roof tiles; drain tiles, rock ceramic slabs for floors, sewer

② Facing materials

Of these, the simplest is the SiO_4^{4-} anion. This anion is present in semi-precious stone zircon, $ZrSiO_4$, and garnets of which $Ca_3Cr_2(SiO_4)_3$ is typical. In the oxy anion $(SiO_3)_6^{12-}$ six tetrahedron are linked through oxygen atoms at two corners to form a hexagonal ring structure. This is the anion present in emerald, $Be_3Al_2Si_6O_{18} \equiv Be_3Al_2(SiO_3)_6$

Most silicate minerals have macromolecular structure in which SiO_4^{4-} tetrahedron are linked to form network in one, two or three dimensions. Two such structures are shown in fig - 8.

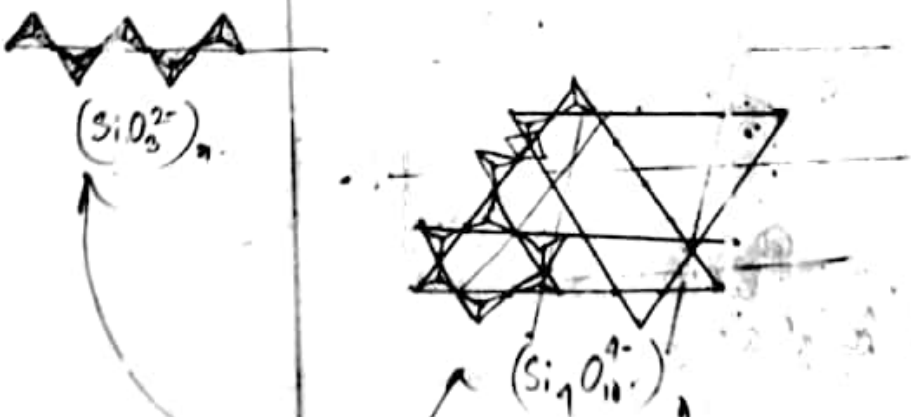


Fig 3 - Two infinite silicate lattices. Asbestos contain a double anion chain similar to the one shown at the left. The structure of mica is that is that of infinite sheet.

RAW MATERIALS.

The raw materials for the silicate industry are very wide spread in nature. They are found in the form of deposites of such common minerals as. clays, limestone, chalk, dolomite, quartz sand. tuff. tripoli, quartzite, feldspars. nepheline and marls.

quartzite: hard, non-foliated metamorphic rock which was originally pure quartz stone

nepheline: tectosil (Na,K)AlSiO4

Marl: Marl are deposited minerals, intermediate between limestone and dolomite.

Clay: clays contain 50-80% $CaCO_3$ and 1 g CO_3 and 20-50% clay sand minerals.

APPLICATION OF SILICATES:

The silicate industry produces extremely important products and have several independent branches. of which the most important are the manufacture of:

(i) Ceramics,
(ii) Refractories,
(iii) Cement & plasters.
(iv) Glass and pyroceramics.