TDC Part III
Paper VI
Inorganic Chemistry

Department of Chemistry

L.S COLLEGE MUZAFFARPUR

B. R. A. BIHAR UNIVERSITY

Dr. Priyanka

TOPIC: - INORGANIC POLYMERS, Aluminosilicates

The aluminosilicates

Very often the silicon atoms are replaced by aluminium atoms to form the silicate analogue, the aluminosilicates. When an aluminium atom replaces a silicon atom, it contributes only three electrons to the bonding framework in place of the four electrons of silicon atoms. The remaining electron is supplied by the ionization of a metal atom such as sodium or potassium.

Sheets

Mica

Mica belongs to a family in which one of the four silicon atoms in the structural unit of talc is replaced by an aluminium atom and inserting a potassium atom to supply the fourth electron needed for electrical neutrality. Mica has a composition of $KMg_3(AlSi_3O_{10})(OH)_2$. Micas are harder than talc and their layers slide less readily over one another. Like talc, crystals of mica cleave easily into sheets. The cations occupy sites between the sheets. The van der Waals attraction between sheets is increased by the presence of extra ionic charge and accounts for the overall hardness of mica over talc.

Three-dimensional network

The ***feldspars***, in which albite $NaAlSi_3O_8$ is an example, are the most abundant aluminosilicate minerals in the Earth surface. The silicon atoms and aluminum atoms occupy the centers of interlinked tetrahedra of SiO_4^{4-} and AlO_4^{5-}. These tetrahedra

connect at each corner to other tetrahedra forming an intricate, three-dimensional, negatively charged framework. The sodium cations sit within the voids in this structure.

Exercise

By referring to Table 1, predict the structure of each of the following aluminosilicate minerals (double chains, sheets, networks, and so forth). In each case, the aluminum atoms grouped with the silicon and oxygen in the formula substitute for Si atoms in tetrahedral sites.

1. $Li(AlSi_2O_6)$
2. $KAl_2(AlSi_3O_{10})(OH)_2$
3. $Al_3Mg_2(AlSi_5O_{18})$

Answers:

1. Network 2. Sheets 3. Closed ring or single chains

<u>Daily life importance of some of the silicate minerals</u>

(a) Silicates

(i) Asbestos (double chains or sheets)

* Asbestos is an excellent thermal insulator that is non-combustible, acid-resistant, and strong. In the past, it was used extensively in construction work to make cement floor tiles, roof covers and ducts.
* It can also be woven into fabric to make fire-resistant blankets.
* Its use has been decreased greatly in recent years because inhalation of small asbestos fibres during

mining and manufacturing or during the removal of frayed and crumbled building materials can cause the lung disease called ***asbestosis***.

(ii) Talc (sheets)

* The common use of talc crystals is to make talcum powder which is a soft and fine powder to make one's skin feel smooth and dry .
* Its resistance to heat and electricity makes it ideal for surfacing benches and switchboards.
* It is also an important filler for paint and rubber.

(iii) Quartz (three-dimensional network)

* The hardness of quartz is widely made use of in construction work as sandstones.
* Quartz/silica tubing are used for high temperature heating.
* Quartz possesses piezoelectric property which enables it to make crystal oscillators used in watches and electronic circuits and also as pressure sensor in electronic balances.
* Quartz is also widely used in jewelry and ornamental decorations.

(b) Aluminosilicates

(i) Feldspar (three-dimensional network)

* In glassmaking, feldspar provides alumina for improving hardness, durability, and resistance to chemical corrosion.
* In ceramics, feldspar is used as a flux, lowering the

vitrifying temperature of a ceramic body during firing and forming a glassy phase.

(ii) Mica (sheets)

* Mica possesses excellent electrical insulation and is widely used in electronic products such as capacitors, washers for transistors and radar high tension coils.
* It also has excellent heat insulation and is used in soldering irons and jet engines