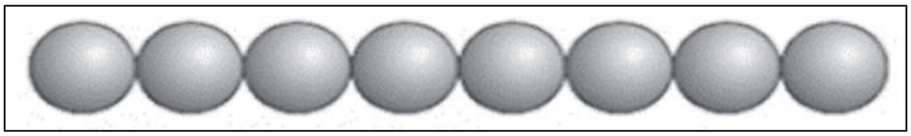
CLOSE PACKED STRUCTURES

For solids characterized by non-directional bonding, their structures are determined based on geometric considerations. In such cases, the lowest energy structure is identified by maximizing the number of neighbors surrounding each particle. To comprehend the structure of these solids, envision the particles as hard spheres of equal size in three dimensions. While numerous arrangements are possible for these hard spheres, the most economical one, known as closed packing, is the arrangement in which the maximum available space is occupied. Now, let's explore the various arrangements of spherical particles of equal size.

Packing in Solid - One dimensional

In one-dimensional close packing, spheres are aligned in a linear fashion, ensuring that neighboring atoms are in direct contact with each other. The coordination number, which denotes the count of nearest neighboring particles, is two in the context of one-dimensional close packing.

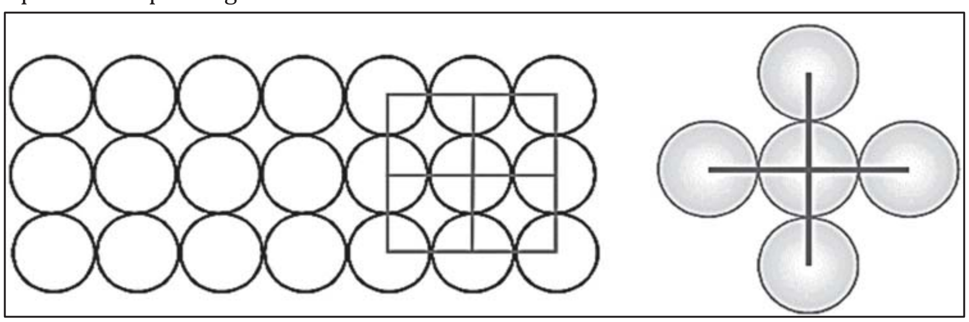


When the spheres are packed in a plane i.e. There are two types of close packing.

Packing in Solid -Two dimensional

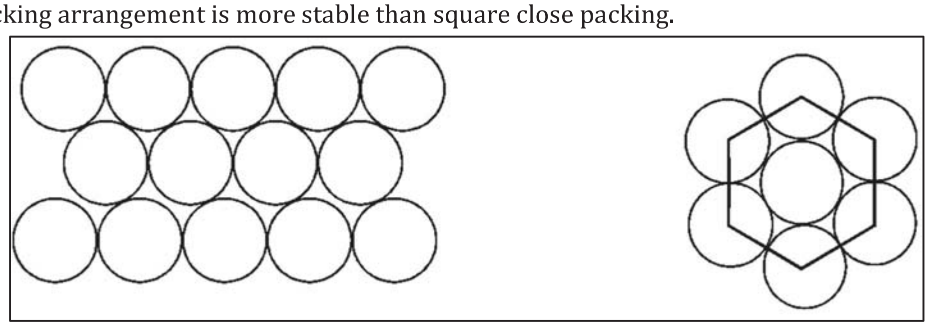
(i) The centers of the spheres are positioned vertically beneath each other in what is known as square close packing. In this arrangement, each sphere makes contact with four other spheres. Approximately 52.4% of the volume is filled, leaving 47.6% as empty space, referred to as void volume.

In square close packing co-ordination number is 4



Square close packing

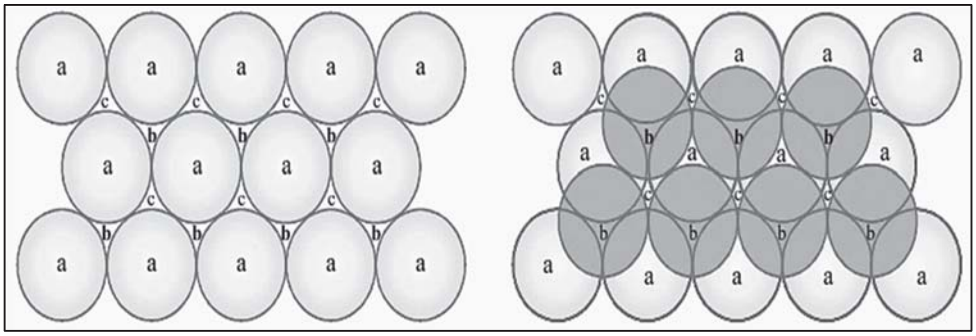
(ii) Below is an illustration of another arrangement of atoms known as hexagonal close packing. In this configuration, each sphere makes contact with six other spheres. Approximately 60.4% of the volume is filled, leaving 39.6% as empty space, referred to as void volume. Consequently, this packing arrangement is more stable than square close packing.



Hexagonal close packing

Packing in Solid - Three dimensional

Within hexagonal close packing, two categories of voids (open or empty spaces) are designated for convenience, labeled as 'b' and 'c.' 'C' spaces are curved triangular areas with upward-pointing tips, while 'b' spaces are curved triangular areas with downward-pointing tips.



Now, we expand the arrangement of spheres into three dimensions by adding a second close-packed layer (hexagonal close packing) (B) onto the first layer (A). The spheres in the second layer can be positioned in spaces labeled as 'b' or 'c.' Importantly, it is not feasible to place spheres in both types of voids (i.e., b and c). As a result, half of the voids in the second layer remain unoccupied. Additionally, the second layer also contains voids of type 'b,' setting the foundation for constructing the third layer.