

MAGNETISM AND MATTER

MAGNETISATION AND MAGNETIC INTENSITY

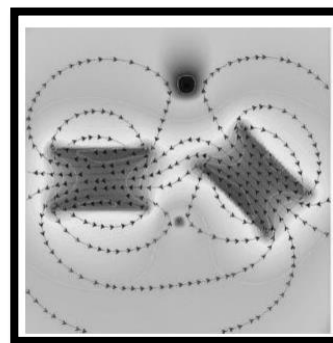
Magnetization and Magnetic Intensity

We have all played with magnets as children. Some of us even play with them now! But, what makes them 'magnetic'? Why don't all the materials and substances possess a magnetic field? Have you ever wondered about it? In this chapter, we will cover the topics of magnetization and magnetic intensity.

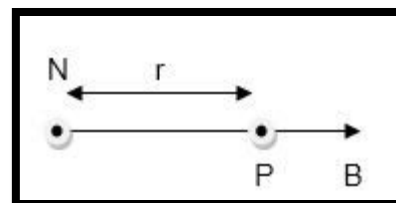
Magnetization

As we know, magnetization results from a magnetic moment. The motion of electrons in the atoms is what induces this. The net magnetization results from the response of a material to the external magnetic field. It also takes into consideration any unbalanced magnetic dipole moment that is inherent in the material due to the motion of its electrons as mentioned earlier.

The concept of magnetization helps us in classifying the materials on the basis of their magnetic property. In this section, we will learn more about magnetization and the concept of magnetic intensity. The magnetic behavior of a magnet is characterized by the alignment of the atoms inside a substance. This is what we will look at in this chapter.



Magnetic Intensity The magnetic intensity at a point is defined as the force that unit north – Pole experiences when it is placed in that field. The intensity of the magnetic field at P due to single pole is given by:



We say that the magnetic field B can be written as:

$$B = \frac{\mu_0}{4\pi} = \frac{m}{\pi r^2}$$

$$10^{-7} \times \frac{m}{\pi r^2}$$

Intensity of Magnetic Field due to a Magnet at Different Points

In Longitudinal Position

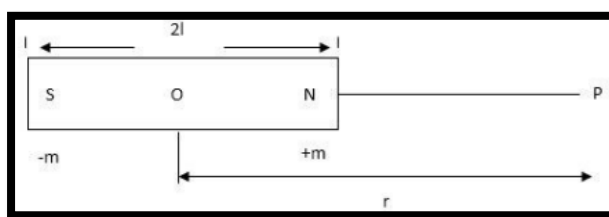
+/-m = Magnitude of the south and north poles

r = Distance of point P from the center of the magnet

l = Length of the bar magnet

Intensity of the magnetic field at point P is given by,

$$B = \frac{\mu_0}{4\pi} \frac{2Mr}{(r^2 - l^2)^2}$$



Where M is the magnetic moment = 2*m*l

Case: For a small magnet, $r^2 \gg l^2$.

In Transverse Position

The intensity of the magnetic field at point P is given by

$$B = \frac{\mu_0}{4\pi} \frac{2Mr}{(r^2 - l^2)^{3/2}}$$

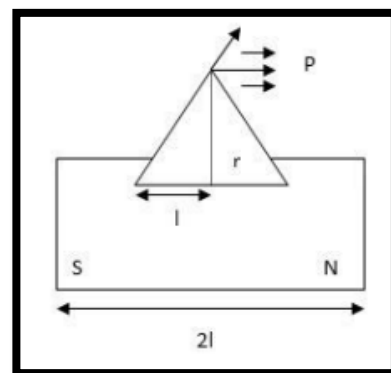
When the magnet is of short length,

In Any General Position

$$B_r = \frac{\mu_0}{4\pi} \times \frac{2M \cos \theta}{r^2}$$

$$B_\theta = \frac{\mu_0}{4\pi} \times \frac{M \cos \theta}{r^3}$$

$$B = \sqrt{(B_\theta + B_r)^2}$$



$$= \frac{\mu_0}{4\pi} \times \frac{M}{r^3} \sqrt{(1 + 3\cos^2 \theta)}$$

And

$$\tan \varphi = \frac{\bar{B}_\theta}{B_r}$$

$$= \frac{1}{2} \tan \theta$$

The direction of is always parallel to the axis from the north to the South Pole in the magnet.

Definition of Intensity of Magnetization

The Magnetic moment of a magnet undergoes a change when it is placed in a magnetic field. This change that is, the magnetic moment change per unit volume is the Intensity of Magnetization. The formula of Intensity of Magnetization

Where, m – Pole strength and A – Area of the cross-section. The S.I unit of intensity of magnetization is Ampere/ meter or A/m

Q. What is the difference between Magnetic Intensity and Intensity of Magnetization?

Ans: The magnetic intensity defines the forces that the poles of a magnet experiences in a magnetic field whereas the intensity of magnetization explains the change in the magnetic moment of a magnet per unit volume.

Q: What do you mean by induced magnetization?

Ans: Induced magnetization is a process where you can magnetize a non-magnetic material. You can do so when you bring it under the influence of an external magnetic field.