Hysteresis Loop: The magnetization and demagnetization of a material in forward and reverse direction under oscillating magnetizing field form a closed loop called hysteresis loop.

Hysteresis loss: The loss of energy per unit volume of the material during a complete cycle of magnetization and demagnetization is called hysteresis loss and it is equal to the area of the hysteresis loop $abcdefa$ in a $B-H$ $curve$. The loss is due to the orientation of the dipoles in one direction and reorientation in opposite direction in magnetization cycle.

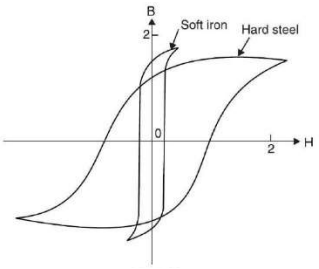
Significance of hysteresis loop:

- ✓ A smaller region of the hysteresis loop is indicative of less loss of hysteresis.
- ✓ Hysteresis loop provides a substance with the importance of retentivity and coercivity. Therefore, the way t o select the right material to make a permanent magnet is made simpler by the heart of machines.
- ✓ Residual magnetism can be calculated from the B-H graph, and it is, therefore, simple to choose material for electromagnets.

Comparison between soft iron and steel.

Soft iron: *Low Coercivity, high Retentivity, narrow hysteresis loop (less energy loss), quickly magnetized and demagnetized, used to make electromagnet, and used in transformer, galvanometer*

Steel: *High Coercivity, low Retentivity, wide hysteresis loop, take long time to magnetized and demagnetized, used to make permanent magnet.*



Some important short questions:

1. *A ferromagnetic substance becomes paramagnetic above a curie temperature. Explain.*

   ⇒According to Curie law, magnetic susceptibility of paramagnetic material is inversely proportional to temperature. The susceptibility of ferromagnetic material decreases with rise in temperature. Due to rise in temperature, the alignment of dipole (molecular magnet) in the magnetic domain gets disturbed and lose their magnetic properties. Above curie temperature, the alignment is completely random and the material becomes paramagnetic.

2. *Why does a bar magnet does not retain its magnetism when it is melted?*
   ⇒ When a magnet is heated, due to thermal energy, the tiny molecular magnets (dipoles) gains kinetic energy and orient itself in any direction. As the temperature increases up to melting point of the material, the orientation (alignment) is completely random and it completely loses its magnetic properties and hence not retain its magnetism.

3. *Why should the permeability of paramagnetic material be expected to decrease with increasing temperature?*
   ⇒The degree to which the magnetic lines of force can penetrate in a substance placed in a magnetizing field is called the permeability of substance. The permeability of substance is, $\mu=\frac{B}{H}$ where B is magnetic induction and H is strength of magnetizing field. When the temperature of paramagnetic material increases, the alignment of dipoles gets disturbed and the value of B decreases. As a result, μ also decreases.

4. *Why soft iron is preferred to make electromagnet and steel is preferred to make permanent magnet. Explain.*