Welcome …

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universal B-H curve

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B-H curve:-

B-H curve means magnetic hysteresis curves by plotting values of **flux density** (B) against the **field strength** (H) .we can produce a set of curves called magnetization curve **.**

$$B \alpha H$$

$$B = \mu H$$

Where , μ= Permeability of free space

- **Flux density (B)** :-

  The magnetic flux density or magnetic induction is the no. of lines of force passing through a unit area of the material.

- **Field strength (H) :-**

  A vector quantity indicating ability of magnetic field to exert a force on magnetic moving charges.

Magnetic Domains :-

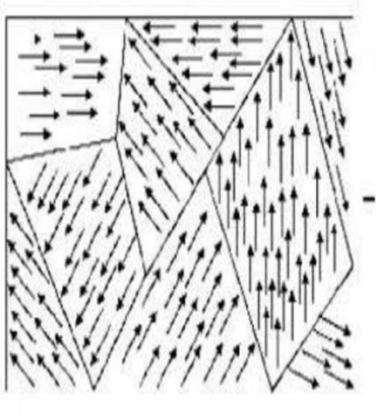


Fig Arrangement Magnetic Domains in materials

Types of Materials and its Domain:-

Diamagnetic Material:-

- These are the substances which in strong external magnetic field, acquire a feeble magnetism opposite to the direction of applied magnetic field.
- Repelled feebly by a magnet.
- No unpaired electrons in them.
- They do not obey Curie's Law.
- M has slightly negative value.
- χ_m has small negative value.
- Relative permeability (μ_r) is less than 1.
- E.g. copper, silver

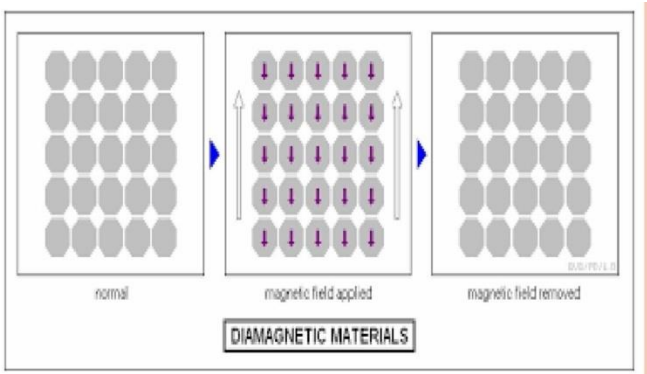


Fig Alignment of domains in Diamagnetic on applying B

Paramagnetic Material:-

- These are the substances which when placed in a strong magnetic field acquire a feeble magnetism in the same direction as the applied magnetic field.
- Attracted feebly by the magnet.
- Unpaired electrons are present in them .
- They follow Curie's Law- $\chi_m = C/T$
- M has slightly positive value.
- χ_m is slightly positive.
- Relative permeability (μ_r) is slightly positive.
- E.g. aluminium, sodium

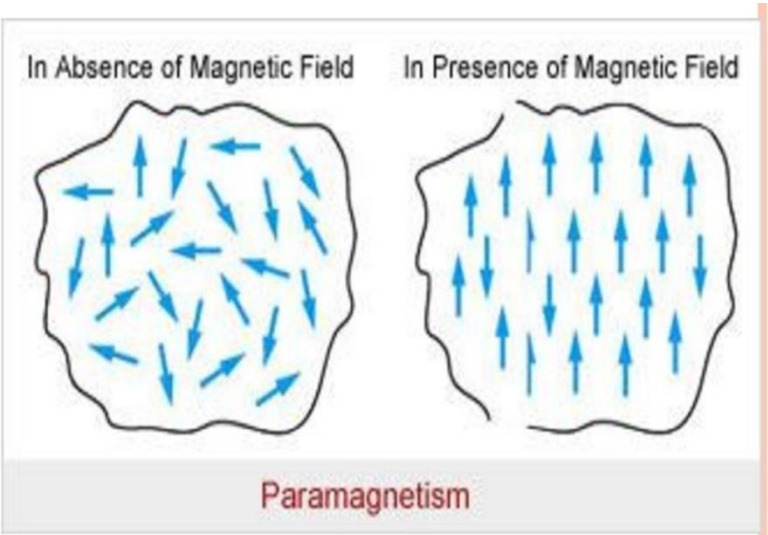


Fig Alignment of Domains in Paramagnetic on Applying B

Ferromagnetic Material:-

- These substances are those which acquire strong magnetism in the direction of applied magnetic field.
- Attracted strongly by the magnet.
- These have randomly oriented domains.
- They do not obey Curie's law.
- M has large positive value.
- χ_m has large positive value.
- Relative permeability (μ_r) has large positive value.
- E.g. Iron ,cobalt

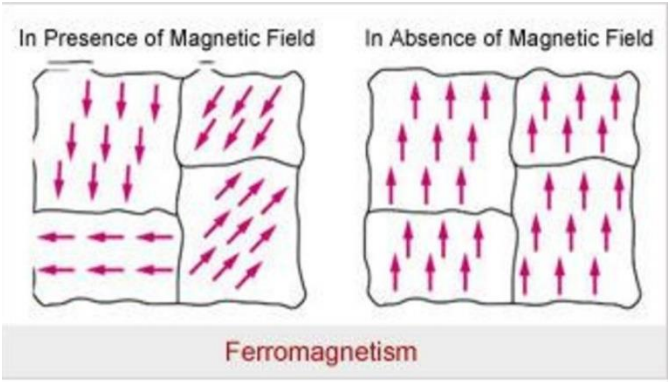


Fig. Alignment of Domains in ferromagnetic on applying B

What is Hysteresis:-

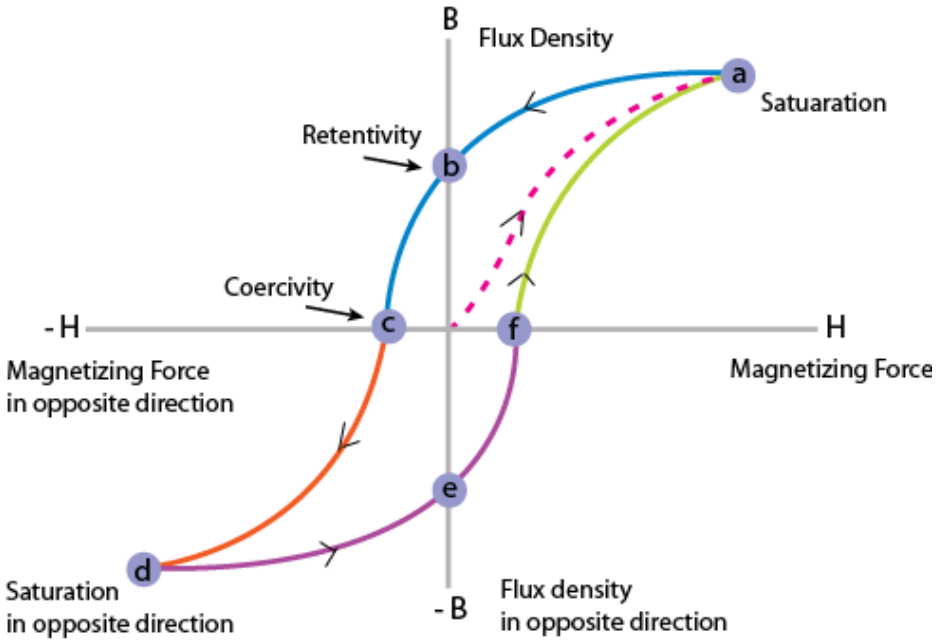
The lag or delay of a magnetism due to the magnetization properties of a material by which it firstly becomes magnetized and then de-magnetized is known as magnetic hysteresis.

A hysteresis loop shows the relationship between the induced magnetic flux density (B) and the magnetizing force (H). It is often referred to as the B-H loop.

Hysteresis Loop:-

If an alternating magnetic field is applied to the material, its magnetization will trace out a loop called ‘Hysteresis loop’.

- **How Hysteresis Loop Works?**



- **Hysteresis loss**

Speciality of B-H curve :-

Magnetic Saturation :-

The unit beyond which magnetic flux density in magnetic area does not increase sharply further with increase of mmf.

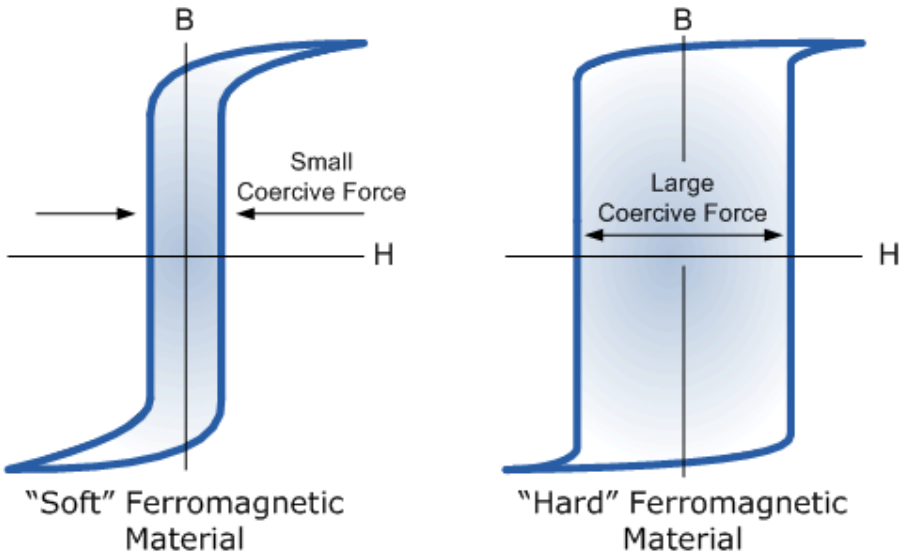
Retentivity :-

The ability of the magnetic field remaining in the material even after removing the external source is known as ‘Retentivity’.

Coersive Force :-

The minimum value of magnetising intensity that is required to bring the material to it’s original state.

- **B-H curves for different material:-**
  - **For soft material :-**
  - **For hard material :-**



Applications of B-H curve :-

As magnetic substances have an extended range of hysteresis loop, these are implemented in the devices such as

- Hard disk
- Audio recording devices
- Magnetic tapes
- Credit cards

Experimental outline：

- **Aim**：To study the hysteresis property of the given magnetic material and hence determine the energy /cycle/unit volume, remain magnetism & core curve field.
- **Instruments**：AC supply, I. C. probe, samples (5 nail, ferrite rod hexa blade), transformation, sampling, CRO etc.
- **Experimental setup :**

- **Formula** : Energy loss$=\frac{0.5\times N}{R\times L}\times S_V \times S_H \times$ area of loop.

Where,

N = No. of turns in coil.

R = Resistance of series switch coil.

L = Coil length.

S_v = Vertical sensitivity of CRO.

S_H = Horizontal sensitivity of CRO.

- **Observations :**

1. No. of turns (N) = 300m.
2. Length of coil (L) = 0.323m.
3. Resistance is series with coil R = 55Ω.

Observations Table :–

I) For sample -1

Obs No.	AC voltage	S_V V/cm	S_H V/cm	Area of loop (cm^2)	Loss of energy/ cycle/ unit volume
1	6V	2.8	4	2.75	133.7461
2	9V	3.6	5.2	3	202.6454
3	12V	4.8	6	3.75	411.6285

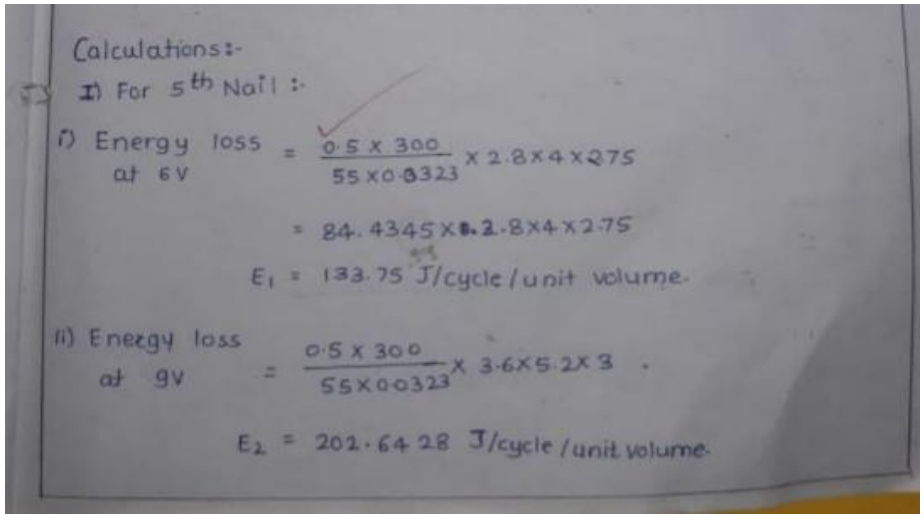
II) For sample -2

Obs No.	AC voltage	S_V V/cm	S_H V/cm	Area of loop (cm^2)	Loss of energy/ cycle/ unit volume
1	6V	2.8	1.2	2.5	147.7623
2	9V	4	1.6	3.25	268.4390
3	12V	4.4	2	4.25	426.152

III) For sample - 3

Obs No.	AC voltage	S_V V/cm	S_H V/cm	Area of loop (cm^2)	Loss of energy/ cycle/ unit volume
1	6V	1.6	2.2	1.75	28.3703
2	9V	1.8	2.8	2.25	53.1944
3	12V	2	3.2	3.25	122.938

Calculations:-



Calculations:-

I) For 5th Nail :-

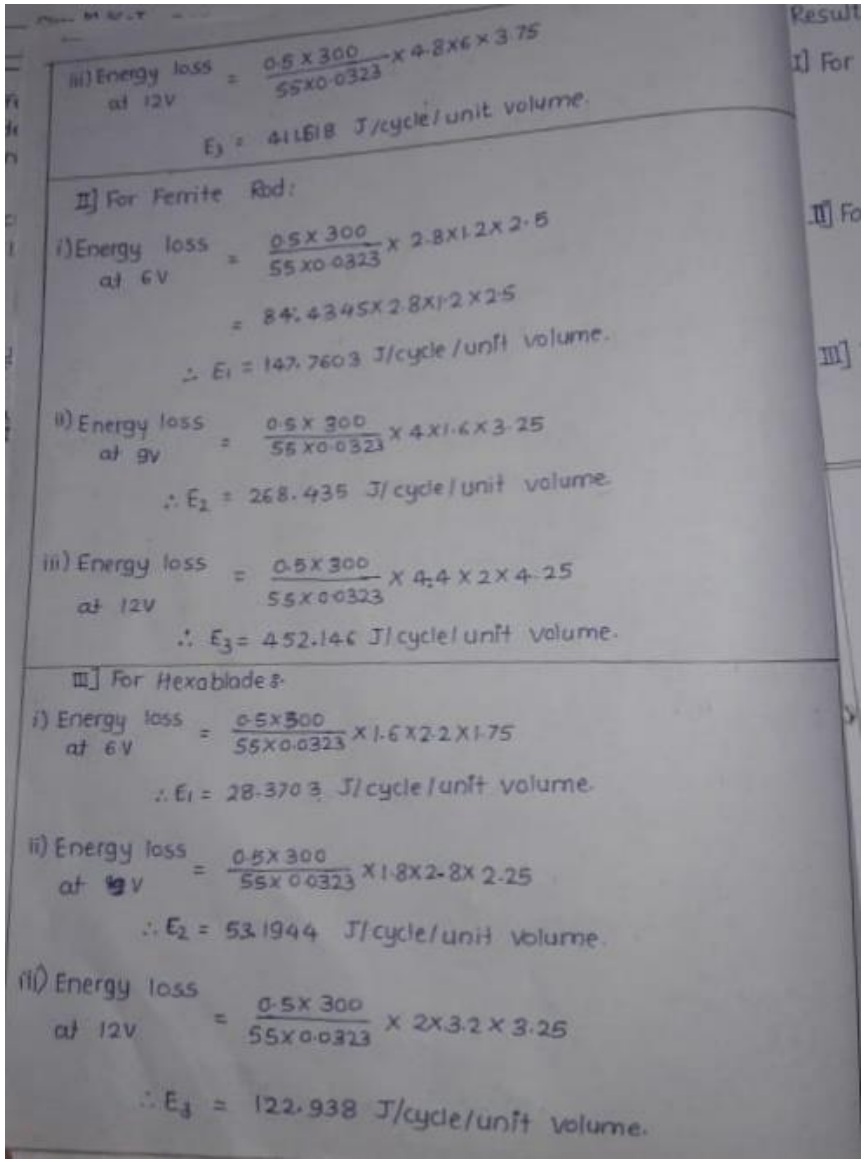
i) Energy loss at 6V = $\frac{0.5 \times 300}{55 \times 0.0323} \times 2.8 \times 4 \times 2.75$

= 84.4345 × 2.8 × 4 × 2.75

E_1 = 133.75 J/cycle/unit volume.

ii) Energy loss at 9V = $\frac{0.5 \times 300}{55 \times 0.0323} \times 3.6 \times 5.2 \times 3$

E_2 = 202.6428 J/cycle/unit volume.



iii) Energy loss at 12V = $\frac{0.5 \times 300}{55 \times 0.0323} \times 4.8 \times 6 \times 3.75$

E_3 = 411.618 J/cycle/unit volume.

II] For Ferrite Rod:

i) Energy loss at 6V = $\frac{0.5 \times 300}{55 \times 0.0323} \times 2.8 \times 1.2 \times 2.5$

= 84.4345 × 2.8 × 1.2 × 2.5

$\therefore E_1$ = 147.7603 J/cycle/unit volume.

ii) Energy loss at 9V = $\frac{0.5 \times 300}{55 \times 0.0323} \times 4 \times 1.6 \times 3.25$

$\therefore E_2$ = 268.435 J/cycle/unit volume.

iii) Energy loss at 12V = $\frac{0.5 \times 300}{55 \times 0.0323} \times 4.4 \times 2 \times 4.25$

$\therefore E_3$ = 452.146 J/cycle/unit volume.

III] For Hexablade:-

i) Energy loss at 6V = $\frac{0.5 \times 300}{55 \times 0.0323} \times 1.6 \times 2.2 \times 1.75$

$\therefore E_1$ = 28.3703 J/cycle/unit volume.

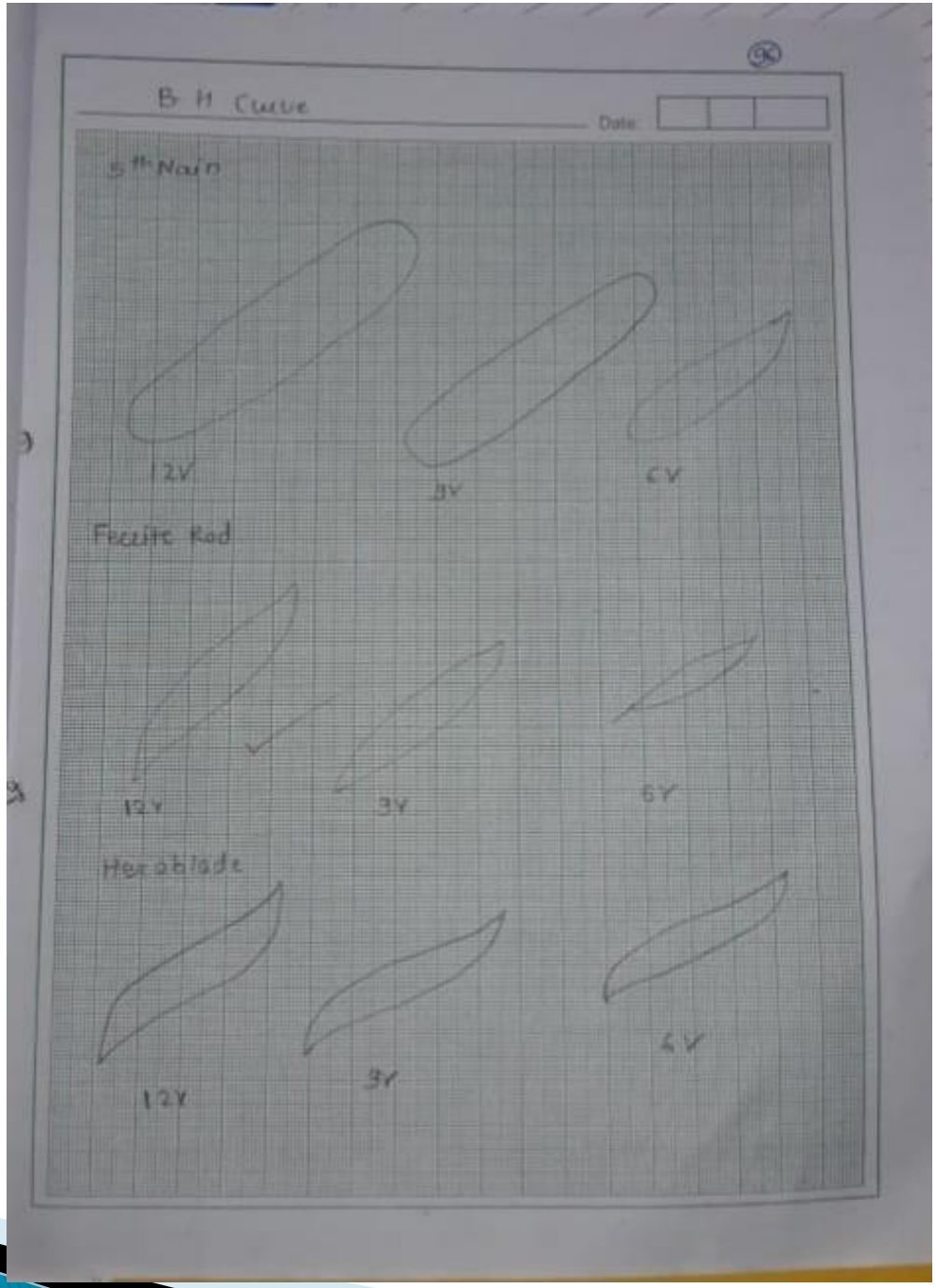
ii) Energy loss at 9V = $\frac{0.5 \times 300}{55 \times 0.0323} \times 1.8 \times 2.8 \times 2.25$

$\therefore E_2$ = 53.1944 J/cycle/unit volume.

iii) Energy loss at 12V = $\frac{0.5 \times 300}{55 \times 0.0323} \times 2 \times 3.2 \times 3.25$

$\therefore E_3$ = 122.938 J/cycle/unit volume.

- **Graph :–**


B H Curve
Date:
5th Main
12V
8V
6V
Ferrite Rod
12V
8V
6V
Herabiade
12V
8V
6V

Result :-

For sample 1st :-

i. E_1 = 133.7461 J/cycle/unit volume

ii. E_2 = 202.6545 J/cycle/unit volume

iii. E_3 = 411.6285 J/cycle/unit volume

For sample 2nd :-

i. E_1 = 147.7623 J/cycle/unit volume

ii. E_2 = 263.4390 J/cycle/unit volume

iii. E_3 = 452.152 J/cycle/unit volume

For sample 3rd :-

i. E_1 = 28.3703 J/cycle/unit volume

ii. E_2 = 53.1937 J/cycle/unit volume

iii. E_3 = 122.936 J/cycle/unit volume

Conclusion

- Hysteresis loop provides information about the magnetic properties of the material. It is important that the B-H hysteresis loop is as small as possible so loss will be less because shape of B-H curve decides the loss. Bigger the area more is the loss vice-versa. The shape of the hysteresis loop depends upon the nature of the material used.