NAME: MAJJIGA JASWANTH
REGNO: 20BCD7171

Experiment - 8

Title:

Hysteresis loop tracer (B-H loop experiment)

Objective:-

- Study of the hysteresis loop for a given ferromagnetic material on a CRO using a solenoid
- To determine the ferromagnetic constants: retentivity, permeability and suspectability by tracing B-H curve

Apparatus required:-

1. CRO
2. ferromagnetic sample
3. Solenoid
4. Hysteresis loop tracer

formula:-

1. Coercivity:-

$$H_c = \frac{G_0 e_x}{\left[\frac{A_s}{A_c} - N\right]}$$

where, $e_x = \frac{1}{2} \times$ loopwidth.

2. Saturation Magnetization:-

$$\mu_s = \frac{J_s}{4\pi}$$

where $$J_s = \frac{G_0 \mu_0 g \times (e_y)_s}{g_y\left(\frac{A_s}{A_c} - N\right)}$$

$(e_y)_s = \frac{1}{2} \times$ tip to tip height

3. Retentivity

$$\mu_r = \frac{J_r}{4\pi}$$

where $J_r = \dfrac{G_0 \mu_0 g_x (e_y)_r}{}$

$(e_y)_r = \frac{1}{2} \times$ intercept

Table :-

	loopwidth	Tip to tip height	intercept
Soft iron	1.4cm	6.4	3.6
Hard Steel	3.2cm	3.4	2
Nickel	4cm	1.2	0.6

Calculations :

I. Softiron

Coercivity :-

$$H_c = \frac{G_0 e_x}{\frac{A_s}{A_c} - N}$$

loop width = 14mm

= 4.66mm (after dividing by multiplying factor by 3)

$e_x = \frac{1}{2} \times$ loop width $= \frac{4.66}{2} = 2.33$ mm

$G_0 = 2.828$ G/mm

$\frac{A_s}{A_c} = 0.133$

$N = 0.0029$

Now

$$H_c = \frac{2.828 \times 2.33}{(0.133 - 0.0029)} = 50.64$$

2. Saturation magnetization :-

$$\mu_s = \frac{J_s}{4\pi}$$

where $$J_s = \frac{G_0 \mu_0 g_x (e_y)_s}{g_y \left(\frac{A_s}{A_c} - N\right)}$$

$g_y = 1$, $g_x = 100$, $\mu_0 = 1$

$\frac{A_s}{A_c} = 0.133$, $N = 0.0029$

$(e_y)_s = \frac{1}{2} \times$ tip to tip height $= \frac{1}{2} \times 6.4 = 3.2V$

$$J_s = \frac{2.828 \times 1 \times 100 \times 3.2}{1(0.133 - 0.0029)}$$

$$= 69558.80$$

Now

$$\mu_s = \frac{69558.80}{4 \times 3.14}$$

$\mu_s = 5.5k$ gauss

3. Retentivity :-

$$\mu_r = \frac{J_r}{4\pi}$$

where $$J_r = \frac{G_0 \mu_0 g_n (e_y)_r}{g_y \left(\frac{A_s}{A_c} - N\right)}$$

$g_y = 1$, $g_n = 100$, $\mu_0 = 1$

$\frac{A_s}{A_c} = 0.133$, $N = 0.0029$

$(e_y)_r = \frac{1}{2} \times$ intercept $= \frac{1}{2} \times 3.6 = 1.8V$

$$J_r = \frac{2.828 \times 1 \times 100 \times 1.8}{1 \times [0.133 - 0.0029)}$$

$J_r = 39016.14$

$\mu_r = \frac{J_r}{4\pi} = \frac{39016.14}{4 \times 3.14}$

$\mu_r = \frac{3106.38}{1}$

$\mu_r = 3.1\text{ K gauss}$

II <u>Hard Steel</u>

loop width = 3.2 cm

= 32 mm

= 10.66 mm (after dividing by the multiplying factor by 3)

Tip to Tip height = 3.4 V

Intercept = 2 V

1. <u>coercivity :</u>

$e_x = \frac{\text{loop width}}{2} = \frac{10.66}{2} = 5.33\text{ mm}$

$H_c = \frac{2.828 \times 5.33}{(0.133 - 0.029)}$

$H_c = 115.8$

2. <u>Saturation magnetization :</u>

$(e_y)_s = \frac{1}{2} \times \text{tip to tip height} = \frac{3.4}{2} = 1.7\,V$

$J_s = \frac{2.828 \times 1 \times 100 \times 1.7}{1 \times [0.133 - 0.0029]}$

$= 36848.57$

$\mu_s = \frac{J_s}{4\pi} = \frac{36848.57}{4 \times 3.14} = 2.9\text{ K gauss}$

3. Retentivity :-

$\mu_r = \frac{J_r}{4\pi}$ $(e_y)_r = \frac{1}{2} \times \text{Intercept} = \frac{1}{2} \times 2 = 1V$

$J_r = \frac{2.828 \times 1 \times 100 \times 1}{1 \times [0.133 - 0.0029]}$

$= 21675.63$

$\mu_r = \frac{21675.63}{4 \times 3.14}$

$= 1725.76$ gauss

$= 1.7K$ gauss

III Nickel

loopwidth = 4cm

= 40mm

= 13.33 mm (after dividing by multiplying factor 3)

Tip to tip height = 1.2V

Intercept = 0.6V

1. Coercivity :-

$e_x = \frac{1}{2} \times \text{loopwidth} = \frac{13.33}{2} = 6.66mm$

$H_c = \frac{2.828 \times 6.66}{[0.133 - 0.0029]}$

$H_c = 144.76$

2. Saturation magnetization :-

$\mu_s = \frac{J_s}{4\pi}$ $(e_y)_s = \frac{1}{2} \times \text{tip to tip height} = \frac{1}{2} \times 1.2$

$= 0.6V$

$J_s = \frac{2.828 \times 1 \times 100 \times 0.6}{1 \times [0.133 - 0.0029]}$

$J_s = 13005.38$

$$\mu_s = \frac{13005.38}{4 \times 3.14}$$

$$\mu_s = 1\text{K gauss}$$

3. Retentivity:

$$\mu_r = \frac{J_r}{4\pi}$$

$$(e_y)_r = \frac{1}{2} \times \text{intercept} = \frac{1}{2} \times 0.6 = 0.3V$$

$$J_r = \frac{28.2 \times 1 \times 100 \times 0.3}{1 \times [0.133 - 0.0029]}$$

$$J_r = 6502.69$$

$$\mu_r = \frac{6502.69}{4 \times 3.14} = 0.5\text{K gauss}$$

Results:

Sample	Coercivity	Saturation Magnetization	Retentivity
Soft iron	50.64 Oe	5.5K gauss	3.1K gauss
Hard steel	115.8 Oe	2.9K gauss	1.7K gauss
Nickel	144.76 Oe	1K gauss	0.5K gauss