Magnetization Properties

1. Objectives

Measure the magnetization curves of a variety of magnetic materials to understand the basic concepts of ferromagnetism. Understand the properties of different materials under different frequency, temperature. Learn the method of using X-Y recorder and oscilloscope.

2. Experimental results

2.1 Properties of specimens and different materials

The basic information of specimens is shown on Table 2.1 *Properties of specimens*.

Table 2.1: Properties of specimens

Material	Type	Le m	Ae m^2	N_1 turn	N_2 turn
Silicon steel	6.5%Si	8.39×10^{-2}	2.04×10^{-6}	30	30
Amorphous	MB	5.50×10^{-2}	1.18×10^{-5}	5	5
Ferrite	H5A	5.33×10^{-2}	2.04×10^{-5}	15	15

Where, L_e is the average length of the inner and outer perimeters of the toroidal specimen, A_e is the cross-sectional area, N_1 and N_1 turns are the turns of the coil.

Below are the equations to calculate:

$$L_e = \pi r^2 = \frac{\pi}{2}(\text{Outer diameter} + \text{Inner diameter}) \qquad (2.1)$$

$$A_e = \frac{1}{2}(\text{Outer diameter} - \text{Inner diameter})\times(\text{Height}) \qquad (2.2)$$

2.2 Measurement of the magnetization curves

The data from X-Y Recorder and B-H Curve Trainer is shown on Table 2.2

Measurement result.

Table 2.2: Measurement result

hgMaterial	X-Y Recorder		Scale Factors	
	Range X axis V/cm	Range Y axis V/cm	A/m/cm	T/cm
Silicon Steel	0.5	0.1	35.76	0.163
	0.5	0.1	35.76	0.163
	0.5	0.1	35.76	0.163
Amorphous	0.5	0.5	4.55	0.085
Ferrite (H5A)	0.25	0.25	28.14	0.082
	0.25	0.25	28.14	0.082
	0.25	0.25	28.14	0.082

2.3 Readings from the graph and Measurement result

We can read the data from Fig. 1, Fig. 2 and Fig. 3, thus we have Table 2.3 *Readings*

from the graph and Measurement result.

Table 2.3: Readings from the graph and Measurement result

Material	Frequency Hz	Temperature ℃	Reading from the graph			Measurement result		
			Hc cm	Br cm	Bm cm	Hc A/m	Br T	Bm T
Silicon steel	100	24	1.46	5.38	6.80	52.21	0.88	1.11
	200		1.80	5.69	6.73	64.37	0.93	1.10
	500		2.43	5.88	6.69	86.90	0.96	1.09
Amorphous	1000	24	0.58	7.08	7.11	2.64	0.60	0.60
Ferrite (H5A)	1000	0	0.46	1.00	5.31	12.94	0.08	0.44
		24	0.41	1.00	4.90	11.54	0.08	0.44
		73	0.31	0.88	3.91	8.72	0.07	0.32

3. Discussion and Conclusion

3.1 Frequency dependency of the hysteresis curve

3.2 Temperature dependency of the hysteresis curve

3.3 Relationship between the differences in shapes of the three samples