PHYF214 PHYSICS LAB REPORT SEM1 2018-2019
Lab 8 Group 7: Ferromagnetic Hysteresis(MB curve)[MB]

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27 th September, 2018

1 Experimental Tasks

1. To study the magnetization (M) of a ferromagnetic material due to an applied magnetic field B and to plot the hysteresis (M vs. B) curve.
2. To calculate the retentivity and coercivity of the material.

2 Apparatus

Two solenoid coils, S and C, ferromagnetic specimen rod, reversible key (R), ammeter, magnetometer, battery, rheostat and transformer.

3 Theory

A ferromagnetic rod is magnetized by placing it in the magnetic field of a solenoid. The magnetized rod causes a deflection () in a magnetometer. The deflection is recorded as the current in the solenoid (I) is varied over a range of positive and negative values

4 Observations

Values of some pre-experiment quantities are described in the following table:

Table 1: Pre-experiment quantities

Diameter of rod (mm)	4
Number of turns of solenoid (n)	1080
Length of rod (cm) (l)	52
Distance from center of rod to magnetometer (cm) (r)	40

The various measurements obtained during the trials are listed below in Table.2 (at the end of the document)
A Graph of I vs $tan\theta$ can be plotted as

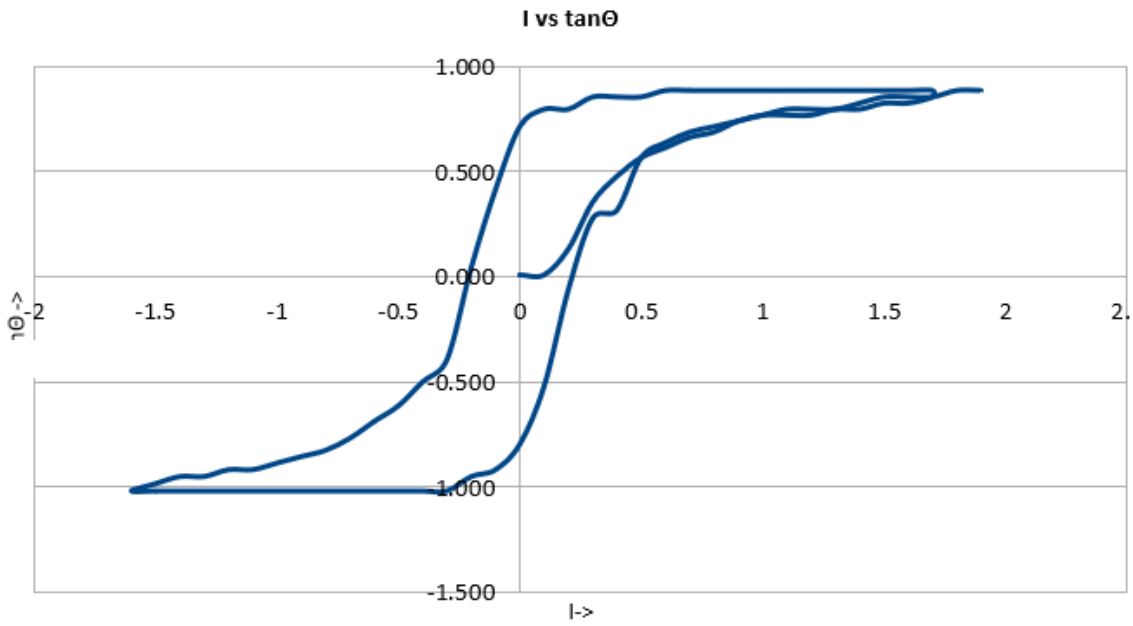

Figure 1: A Graph of I vs $tan\theta$

4.1 *Analysis:*

We know that
From the graph, $tan(\theta) = 0.49$

$$M = \frac{4\pi}{\mu_0 \alpha(2l)} \frac{(r^2 - l^2/4)^2}{r} B_E \tan\theta$$

Horizontal component of earths Magnetic Field (B_E) = 39.26
Distance from center of rod to magnetometer (r) = 0.4m
Length of rod (l) = 0.52 m
Cross sectional area of the rod $\alpha = \pi(0.002)^2 = 12.57m^2$
$M_0 = 2.26x104weber/m^2$
Number of turns (n) = 1080
From the graph (I0) = 0.19 A
B_0 =$2.58x10^{-4}$ oersted
Error calculation :

Least count of bench = 0.1cm
Least count of micrometer screw = 0.02 mm
Least count of the Multimeter = 0.01 A

Error in measuring retentivity is $\pm 0.19x10^4 weber/m^2$
Error in measuring coercivity is$\pm 0.15x10^{-4}$
oersted
So,
$M_0 = (2.26 \pm 0.19)x10^4 weber/m^2$
$B_0 = (2.6 \pm 0.14)x10^{-4}$ oersted

5 Precautions

- To get strictly zero current you will have to switch off the battery.
- Strictly follow a current variation sequence. Do not change or back-track will lead to incorrect results.
- Ensure that there is no deflection of the needle after demagnetizing rod.

Table 2: Experimental Data

θ_1	θ_2	$< \theta >$	Current I (in A)	$Tan\theta$
1	0	0.5	0	0.009
0	1	0.5	0.1	0.009
7	8	7.5	0.2	0.132
19	20	19.5	0.3	0.354
25	26	25.5	0.4	0.477
29	30	29.5	0.5	0.566
31	32	31.5	0.6	0.613
33	34	33.5	0.7	0.662
34	35	34.5	0.8	0.687
36	37	36.5	0.9	0.740
37	38	37.5	1	0.767
37	38	37.5	1.1	0.767
37	38	37.5	1.2	0.767
38	39	38.5	1.3	0.795
38	39	38.5	1.4	0.795
39	40	39.5	1.5	0.824
39	40	39.5	1.6	0.824
40	41	40.5	1.7	0.854

41	42	41.5	1.7	0.885
41	42	41.5	1.6	0.885
41	42	41.5	1.5	0.885
41	42	41.5	1.4	0.885
41	42	41.5	1.3	0.885
41	42	41.5	1.2	0.885
41	42	41.5	1.1	0.885
41	42	41.5	1	0.885
41	42	41.5	0.9	0.885
41	42	41.5	0.8	0.885
41	42	41.5	0.7	0.885
41	42	41.5	0.6	0.885
40	41	40.5	0.5	0.854
40	41	40.5	0.4	0.854
40	41	40.5	0.3	0.854
38	39	38.5	0.2	0.795
38	39	38.5	0.1	0.795
35	36	35.5	0	0.713
22	23	22.5	-0.1	0.414
2	3	2.5	-0.2	0.044
-22	-21	-21.5	-0.3	-0.394
-27	-26	-26.5	-0.4	-0.499
-32	-31	-31.5	-0.5	-0.613
-35	-34	-34.5	-0.6	-0.687
-38	-37	-37.5	-0.7	-0.767
-40	-39	-39.5	-0.8	-0.824
-41	-40	-40.5	-0.9	-0.854
-42	-41	-41.5	-1	-0.885
-43	-42	-42.5	-1.1	-0.916
-43	-42	-42.5	-1.2	-0.916
-44	-43	-43.5	-1.3	-0.949
-44	-43	-43.5	-1.4	-0.949
-45	-44	-44.5	-1.5	-0.983
-46	-45	-45.5	-1.6	-1.018
-46	-45	-45.5	-1.5	-1.018
-46	-45	-45.5	-1.4	-1.018
-46	-45	-45.5	-1.3	-1.018
-46	-45	-45.5	-1.2	-1.018
-46	-45	-45.5	-1.1	-1.018
-46	-45	-45.5	-1	-1.018
-46	-45	-45.5	-0.9	-1.018
-46	-45	-45.5	-0.8	-1.018

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-46	-45	-45.5	-0.3	-1.018
-44	-43	-43.5	-0.2	-0.949
-43	-42	-42.5	-0.1	-0.916
-39	-38	-38.5	0	-0.795
-28	-27	-27.5	0.1	-0.521
-4	-3	-3.5	0.2	-0.061
15	16	15.5	0.3	0.277
17	18	17.5	0.4	0.315
29	30	29.5	0.5	0.566
32	33	32.5	0.6	0.637
34	35	34.5	0.7	0.687
35	36	35.5	0.8	0.713
36	37	36.5	0.9	0.740
37	38	37.5	1	0.767
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