Measurement of the Magnetic Field in the Single Sheet Tester 500 * 500 mm^2

Badreddine Naas, Dahmane Hachi, Hakim Hammache, Bachir Naas, Djelloul Moussaoui

Abstract: ***This paper describes how magnetic field H is measured for magnetic sheet materials used in electrical engineering. The measurement technical are tested in single sheet tester device which can gives alternating magnetic properties under unidirectional and sinusoidal flux density.***

Index Terms: ***Single Sheet tester SST, Epstein frame, H coils methods, eddy currents, magnetic measurement.***

I. INTRODUCTION

Highlight a section that you want to designate with a certain style, and then select the appropriate name on the style menu. The style will adjust your fonts and line spacing. **Do not change the font sizes or line spacing to squeeze more text into a limited number of pages.** Use italics for emphasis; do not underline. The determination of the magnetic quality of materials based mainly on the nature of the measurement systems used. The evolution of the standard in the field of characterization of the material is an important factor to take into account the physical nature of the magnetic materials and the conditions of their use. The reproducibility of the measurement and ease of handling are also factors that allow you to choose the type of magnetic circuit to implement. Part single band (SST) is a measuring device for characterizing magnetic materials, it is used in the electrical industry [1], several laboratories have developed several variations of SST frame, and they are distinguished by the arrangement of yokes (horizontal or vertical) and also by the size of the measurement sample. To better take into account the evolution of soft materials, the electrical laboratory EMP is committed to the development of a frame work for OSH for the characterization of large sample size, it is composed Fig.1:

- Two yokes for the pipeline magnetic flux
- A primary excitation winding
- A secondary winding arranged to measure the flow of the sample around
- Two flat coils for measuring tangential field.

The framework can characterize samples with dimensions as 500* 500 mm^2 for this size annealing is not required, the use of the framework can be considered to conduct studies in areas such as (mechanical strain, CND, testing and implementation of new sensor ... etc.).

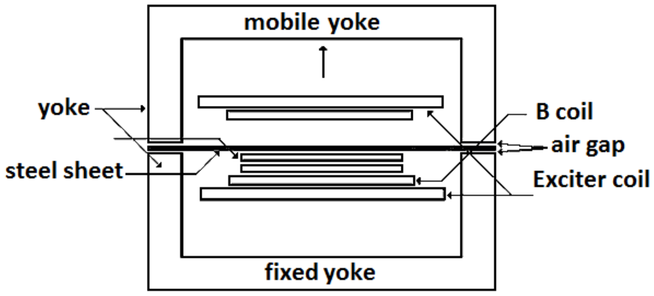

Fig. 1 Single Sheet Tester SST 500*500 mm2

II. MEASURING MAGNETIC PROPERTIES

The experimental determination of the magnetic quantities requires knowledge of the form of the magnetic induction B and that of the H field is first obtained by a coil arranged around the sample, from a second coil placed on the surface of the sample, this method is more precise than method called the primary current, because it gives direct information on the field at the surface of the sample.

A. Measure of Field by magnetizing current

This method is standardized. The field is calculated from the measurement of the primary current with the Ampere. As is indicated by the following relationship:

$$H_m = \frac{N_{exc} I}{L} \qquad (1)$$

H_m : Magnetic field measured by the method currents magnetize.

L : Effective length of the magnetic circuit.

I : Excitation current.

N_{exc} : Number of turns of the excitation coil.

B. Measurement of induction by H Coil

This measurement method characterized ESS frame relative to that of Epstein, the measurement is based on the principle of the conservation of the tangential component of the field at the surface of the sample [2], [3], [4].

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This coil is appropriately sized correctly positioned relative to the sample criteria are the same as for the method to two tangential coils described in the following paragraph, to measure a voltage induced by variation of the flux.

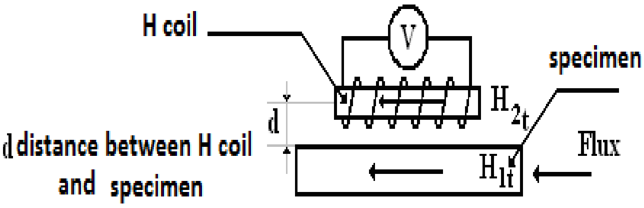

Fig. 2 Principle of Measurement of induction by H coil

We have:

$$B_{bob} = \mu_0 H_{2t} \qquad (1)$$

From the continuity of the tangential component is therefore:

$$H_{1t} = H_{2t} \qquad (2)$$

The magnetic field distribution of the sample is uniform; the field value is derived as follows:

$$V_{bob} = -n_{bob} \frac{dB_{bob} S_{bob}}{dt} \qquad (3)$$

Finally, the value of the field in the sample is determined by integrating equation

$$H_{bob} = -\frac{1}{S_{bob} n_{bob}} \int_0^T V_{bob} dt \qquad (4)$$

C. *Measurement of Induction by Two H Coil*

This method consists in deducing the H_0 field developed on the surface of the sample from the measurements obtained using a coil located in a distance d_1 and a further reel located at a distance d_2, while assuming the variation of the field is linear over a small distance, is derived by linear interpolation H_0 measurements supplied by the two coils.

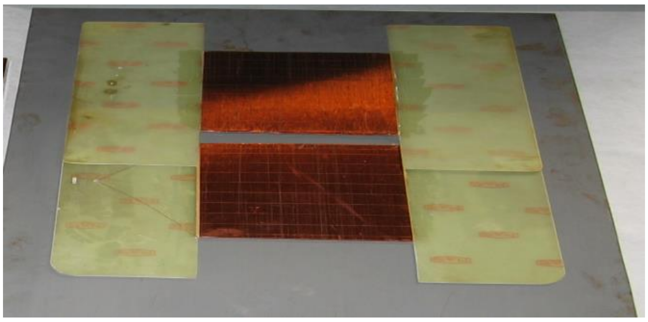

Fig. 3 Steel Sheet with Two H coil Measurement of Induction

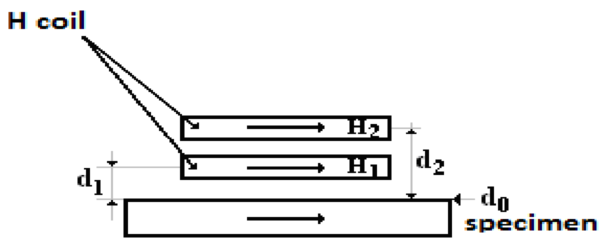

Fig. 4 Principle of Measurement of Induction by two H Coil

The magnetic field is proportional to the distance between the coil and the surface of the sample.

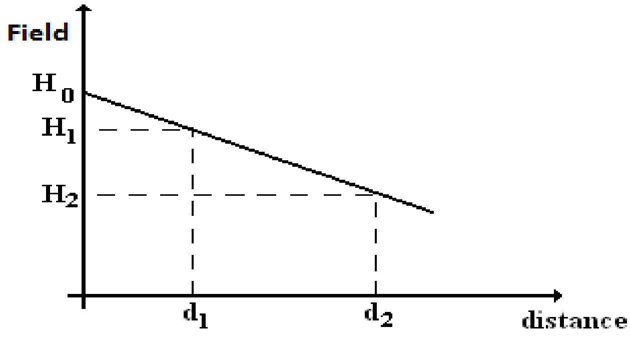

Fig. 5 Determination of the Field on the Surface of the Sample by Interpolation of the Measurements of the Fields H1 and H2.

$$H_1 = H_0 + K.d_1 \qquad (6)$$

$$H_2 = H_0 + K.d_2 \qquad (7)$$

H_0: Field of the sample inferred by interpolation.

H_1: Field measurement in the first tangential coil.

H_2: Field measurement in the second tangential coil.

d_1 : Distance between the first coil and the sample.

d_2 : Distance between the second coil and the sample.

K : Coefficient of proportionality between the magnetic field and the distance between the coil and the sample.

The field value in the sample is then deduced by:

$$H_0 = H_1 \frac{d_2}{d_2 - d_1} - H_2 \frac{d_1}{d_2 - d_1} \qquad (8)$$

The following figure shows the overall scheme of the frame 500 × 500mm^2 SST:

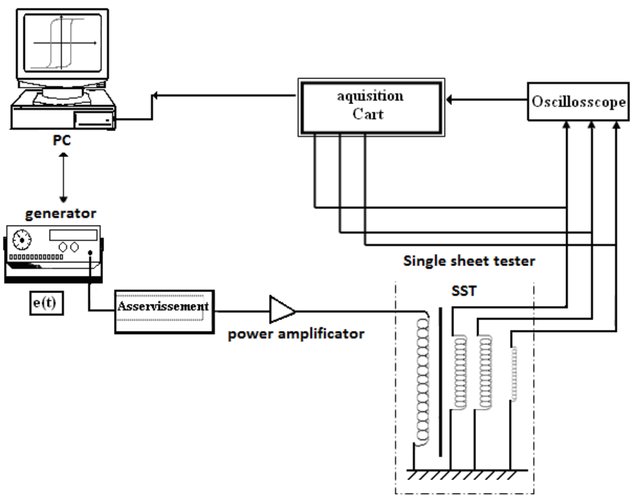

Fig. 6 Banc of Single Sheet Tester

The prototype made SST type one Yoke represented by the following figure:

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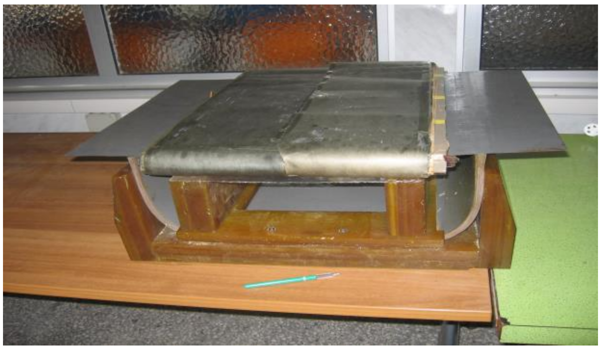

Fig. 7 Single Sheet Tester SST Frame 500 * 500mm2 Realized, Presenting a one Yoke (Half-Cylinder)

D. Figures

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II1.MESURE FIELD BY magnetizing current
This method is standardized. The field is calculated from the measurement of the primary current with the Ampere. As is indicated by the following relationship:

III. RESULTS

The signals obtained from various sensors associated to the tester SST type one cylinder is present in Figure 8. The digital oscilloscope used to view signals in four channels, the first channel is the voltage sensing by the Hall effect sensor of the electric current picture, the second channel is the secondary voltage, the third channel for the voltage terminal of the first field coil tangentially, the last channel to the voltage obtained by the second coil tangentially.

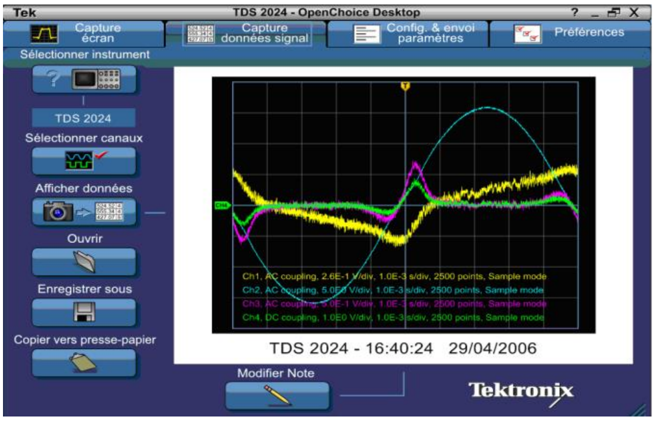

Fig. 8 Signals from Various Sensors Associated with the Tester SST

The voltages at the two tangential H coils shown in Fig 9.

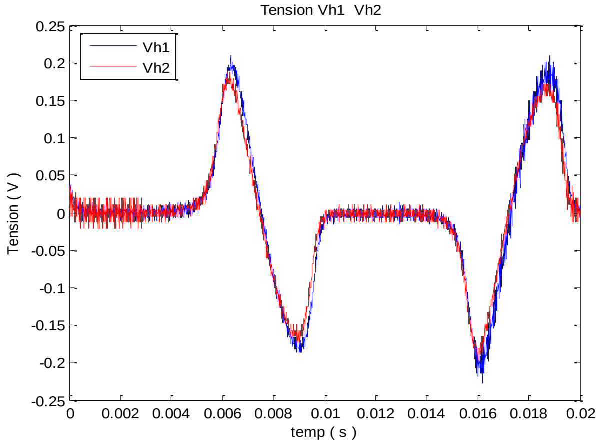

Fig. 9 Voltages Obtained by Two H Coils

After numerical integration of the two previous signals, magnetic fields are shown in the following figure:

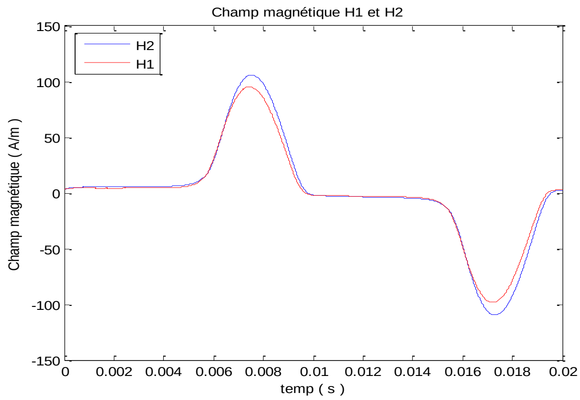

Fig. 10 Two Fields H1, H2

The field obtained after linear extrapolation is represented by the figure above, it is the magnetic field on the sample.

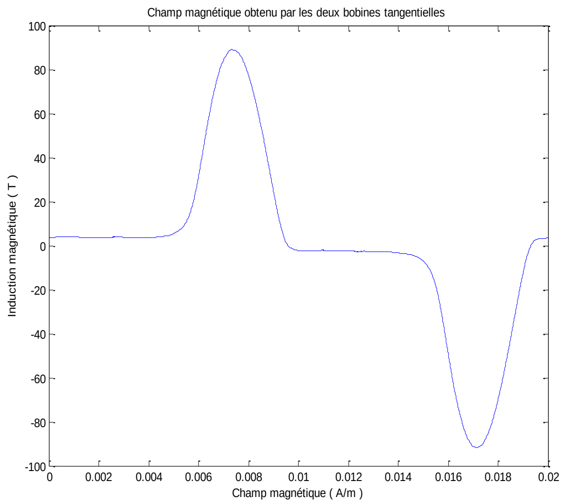

Fig. 11 Resulting Field Obtained by Interpolation of the Two Fields

The following figure shows the hysteresis loop obtained by each tangential coil.

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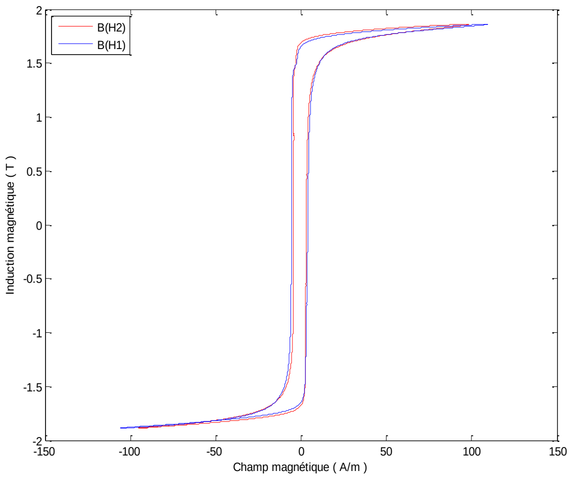

Fig. 12 Both Hysteresis Loops of Magnetic Fields H1, H2

The resulting hystericises cycle B (H) of the sample obtained by using the method of two tangential coils.

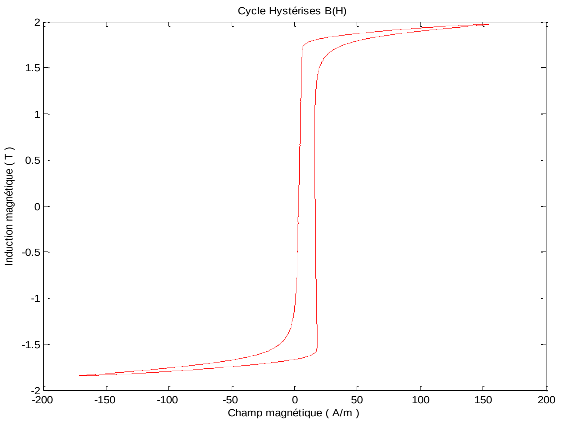

Fig. 13 Hysteresis Cycle Obtained by Two H Coils

IV. Conclusion

We described the principle of the method of tangential coil for measuring the magnetic field H because the frame geometry is very complex and far field from the primary current is not representative. The experimental implementation of the technique allowed us to justify the importance of having two tangential coils and subsequently extrapolate the two measured quantities.

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