ACCURACY OF MAGNETIC VALUES MEASUREMENT

Ing. Lucie MUNDUCHOVÁ, Doctoral Degree Programme (1)
Dept. of Electrical Power Engineering, FEEC, BUT
E-mail: xmundu00@stud.feec.vutbr.cz

Supervised by: Prof. Karel Hruška

ABSTRACT

Work deal with accuracy of measurement ferromagnetic material at alternating magnetizing, method of magnetizing samples and waveform of alternating magnetic induction and magnetic field strength. A fail associated with methods most often incident at analyze magnetic measuring

1 INTRODUCTION

So that could express inaccuracy measuring and evaluation requested parameter produce at the industrial using, error analysis is need create, what we can do at measuring given to produce, what has influence on measuring produce and how this failure correct at the practice.

Measurement and verification at the same time be instrumental to next acquisition updated finding and to elaboration-updated possibility to better production, measurement and verification. That makes possible improvement technology and construction, but also perfection accuracy measuring instrument and method, possibilities of control. Continuous cycle amelioration and perfection reflects implementing modern technology and urgency improvement verification thereby to urgency precise measurement.

Very often consumer request material with specifically parameters, that is standardization, but for want of knowledge and experience about how and wherewith those measure, product is not measured and specifications about this product are determination only according to standard specifications.

Czech Republic's standards were changed in vast majority to satisfy European Union's requirements since year 1990. Some standards, that are unvalid, are taken over from EU and translated; some standards are just cancelled and no replaced. The standards, which were cancelled and no replaced include for example standard for measuring magnetic soft material using for alternating magnetization - standard ČSN 34 5675 Measurement magnetic soft material. This standard was cancelled since 1995 and for the present isn't replaced.

2 FAILURE OF MAGNETIC MEASUREMENT

Magnetic measuring as every measurement is coming only to approximate value, which is different from correct, because measuring data are biased by various errors in measurement. That is engaged in this work above all systematic error, i. e. error, whose rise is in measuring of samples and errors consisted in used method.

So that precede wrong method, it is necessary let know, if is going about field dimensional, or small, if have high magnetic field strength, or low and if these are field homogenous or inhomogeneous. What are targets of our measurement and how we can do it.

On source of error has influence multiplicity factor. For example material - failure of grid contravene homogeneity magnetic field and is causes rise of stray field, as well waveform tested sample, mechanical stress, temperature and so on.

Errors of samples are caused by inhomogeneous of samples. Influence of material in homogeneity claim especially high near soft-magnetic materials.

Tested sample may not be under stress. Flexion or wrench of samples can conduce to high error. That is need watch temperature of samples, which to us is able to warm and result magnetic measuring would be interference errors, which has origin in temperature change.

Form of samples should be homogeneous. E.g.: "cylindrical sticks would be cylindrical and no conical.

So that were given reliable record, is necessary, to was performance claim on homogeneous magnetization of measuring samples. That is why is need, complete sample stand in homogeneous magnetic field, if need be count distortion.

Other sources of error can stand error whose we permit using samples, which has not been demagnetization.

Next error is location of samples appearance to global field or another magnetic field. Location has been such; we start from zero magnetic position of samples.

If we let know, what material we will measure and what about we need measure, so is need intend above method, which using, because almost at every one method find for her characteristic error, if need be several errors. Errors, which offer in using method, are various and will make a difference on using method.

3 METHOD OF MEASURING FERROMAGNETICAL MATERIALS AT ALTERNATING MAGNETISING

Alternating magnetization there, where field strength H and magnetic induction B material has alternate running, i.e. periodical running without direct components. If the running include also equable (constant) components, is concerned alternately magnetization in the presence of direct magnetization.

Coil, which is energized from power supply alternating current, excite magnetic field. Coil are stoking to checking solid, or solid goes through core coil.

3.1 PROCESS OF MAGNETISING

Directions of spontaneous magnetization ferromagnetic materials are in of all direction crystallography walls. Magnetic moments are unchanging suddenly owing to incidence mutual power smooth transition from one orientation to the second.

If outfield begins take effect upon this wall, spins will go cross over to the direction field, or to the direction compared with field advantageous and it reversible or nonreversible.

Magnetization's vector turns medial symmetric at alternating magnetization and HB-loop matches some cycle of magnetization, that's symmetrical about mean.

Magnetization samples is influence series effect at alternating magnetization ferromagnetic samples time alternating magnetic field, those effects influence waveform and values magnetic induction.

At alternating magnetization of ferromagnetic samples consist not only on values of induction and intensity, or on their frequency, but also on waveform time behaviors.

4 WAVEFORM ALTERNATING MAGNETIC INDUCTION AND MAGNETIC FIELD STRENGTH

Waveform turns owing to nonlinear coil, so waveform will be nonlinear (see figure 1).

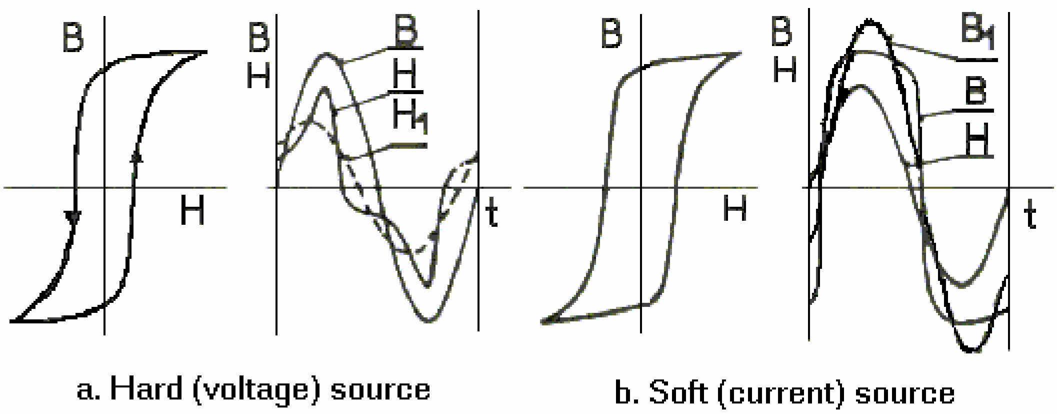

Fig. 1: *BH-loop depending on source and waveform of magnetic intensity and induction; a. Hard (voltage) source, b. Soft (current) source*

4.1 POWER SUPPLY

If field of coil will be energized from voltage supply with harmonic voltage waveform, then current will be no harmonic in circuit and voltage harmonic. This nonlinear is given by coil.

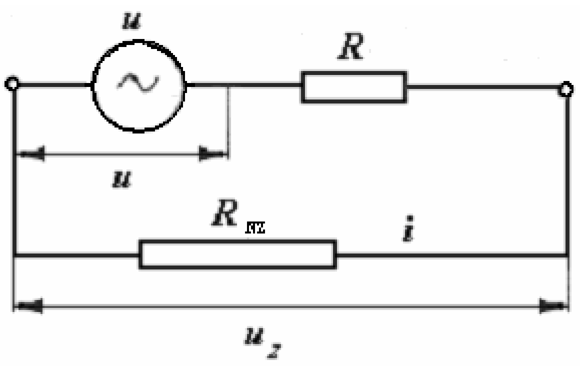

Fig. 2: *Connection diagram of Power supply*

They may come three example of magnetization: according to character of power supply sine wave - current magnetization, voltage magnetization, or magnetization immixture that is of combination of both precedents.

Magnetic field of coil has at current magnetization of exciting current harmonic wave, but induction of magnetic field and voltage are biased (see figure 1b).

It is due to thereby, that is ohm resistance of circuit opposite reactance of coil high $R >> \omega L_1$ Compared to voltage magnetization, when ohm resistance of circuit is very small opposite reactance of coil $R << \omega L_1$, clamp voltage of coil and induction magnetic field in grain have harmonic wave, time behaviors of intensity magnetic field and exciting current is distortion (see figure 1.a).

Composite magnetization occurs sometimes in practice, that's combination of both precedents.

HB-loop will be narrower and more tilted at current magnetization, than it is by voltage magnetization.

If source is hard →voltage is harmonic, current in circuit is no-harmonic and voltage on load is harmonic. $i = \dfrac{u}{R + R_{NZ}}$

That is valid for terminal voltage of field coil: $u = R_C i + N \dfrac{d\phi}{dt}$

$$u = R_C i + N \frac{d(BS)}{dt} = R_C i - NS \frac{dB}{dt}$$

If we can vanish resistance of coil (RC=0) we get: $u = NS \dfrac{dB}{dt}$

We can count induction as:

$$B = \frac{1}{NS} \int_0^t u dt = \frac{1}{NS} \int U_m \sin \omega t dt = -\frac{U_m}{NS\omega} \cos \omega t = B_m \cos \omega t$$

SYMBOLS

ω – rotating speed

L_1 – inductivity of coil

H – magnetic intensity

B – magnetic induction

i – exciting current

u – voltage of source

R – linear resistance

R_{NZ} – nonlinear resistance

R_C – resistance of coil

ϕ – magnetic flow

S – sample cross-section

N – number of wind

B – sample magnetic induction

U_m – amplitude of voltage

B_m – amplitude of induction

CONSTRUCTION

Basically content of the presented work is source of error magnetic measuring and those corresponding uncertainties

That participates on errors magnetic measuring for example:

- Choice of using the method
- Stress and temperature, location, magnetizing field
- Errors of samples (inhomogeneous, shape, material)
- Character of power supply (that affect on form of faithlessness owing to hysteresis)

This all factors play roll in expression of uncertainly of magnetic measuring.

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