METHOD OF DETERMINATION THE QUALITY OF THE MAGNETIC CORE

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Introduction. The essence of the method is to reduce the cost and time to diagnose the magnetic core, in comparison with the methods known before [1].

At the repair shops and workshops, where magnetic core is being repaired, have the task of determining the quality of the magnetic core with the simplest, most efficient and least expensive method. They should determine whether magnetic core can be used, because poor quality magnet core can damage the winding, which will cause the machine to fail.

In this way is needed not quantitative description of the quality of the magnetic core, how much is qualitative.

When deterioration of the magnetic core, the component of losses on the eddy currents, which depends on the square of the frequency, increases. It is proposed to use a technique based on the effects of eddy current and surface effect at frequencies higher than industrial.

Main part. The idea of the method is as follows: each eddy current, when flows, creates its own magnetic flux, flows from eddy currents to interact with the main magnetic flux, and since these flows are directed towards each other, then there is a weakening of the resulting magnetic flux.

Thus, since the loss of eddy currents in the damaged magnetic core is increased, then it can be observed a stronger weaking of the magnetic flux.

In order to obtain more illustrative and expressive results, it is suggested to conduct measurements at frequencies above 50 Hz. Because on frequency higher then network frequency, begins to show a superficial effect and losses will increase in quadratic law.

In this case, it is useful and the benefit of it is that, with the surface effect, eddy currents will be concentrated near the edges of the sheet and the flows from these currents will be stronger and as a result the resultant flow will be further weakened. With increasing frequency there are two opposing tendencies, the first - with increasing frequency, linearly increasing loss of hysteresis, and losses on eddy currents grow quadratically, and the second trend - the surface effect appears, which leads to a decrease in the active section of the sheet of the magnetic core and as a result the flow and losses fall also are decreasing. Therefore, it is not enough simply to ask a high frequency value, but it is necessary to determine the most suitable values of the frequency at which the demagnetizing effect from eddy currents is the most obvious.

The methodology based on this method will be the following: on a magnetic core, it is necessary to wind several turns of a working winding, which is supplied from the frequency generator and one turn of the measuring winding. The scheme of the proposed method is depicted in Figure 1.

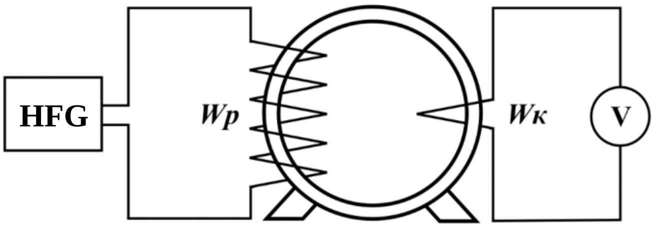

Figure 1 – Scheme of the proposed methodology

Carry out the measurements for two values of the frequency while maintaining the value of the voltage at the working winding constant. Then it is necessary to find the relation between the voltage values on the measuring winding at these two points. According to our theory, if f_1 and f_2 are the frequencies for which the experimental points were removed, where f_1 is the frequency corresponding to the larger value of the EMF – E_1, and f_2 is the frequency corresponding to the lower value of EMF – E_2, the value of the ratio E_2 / E_1 will be greater for the qualitative magnetic core and, accordingly, smaller for a magnetic core with defects [2, 3].

At what frequency values it is best to shoot points, is still need to find out. We need to find such values at which the difference between the values of the EMF for a defective and nondefective magnetic core will be significant. To do this, you need to conduct experiments and calculations and identify the following points. With the use of this technique, the received EMF ratio of the any magnetic core will be compared with the statistical data obtained earlier from magnetic cores with different quality states, and to conclude on the state of the magnetic core. Thus, the need for a etalon data disappears, which makes this method rather simple in execution and suitable in use. In addition, in repair shops there are special brackets that can be installed on the back of the magnetic core and so do not even need to waste time for winding the turns.

Experimental verification of the method. In order to verify whether the proposed method has results expected from physical dependence, a number of experiments on magnetic cores of various sizes and the state of interlayer isolation were conducted. For this purpose, the circuit shown in Figure 1 was collected and the value of the voltage on the secondary winding was measured at a frequency range of 50 Hz to 20 kHz. The results of experiments for each of the researched magnetic cores will be given below.

The graph of the voltage dependence on the frequency for the magnetic circuit of the 4AA63V4U3 series of 0.37 kW is shown in Figure 2.

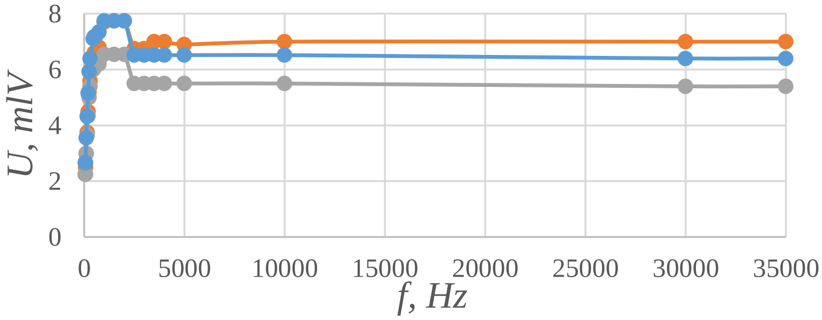

Figure 2 – The graph of the voltage dependence on the frequency for the magnetic circuit of the 4AA63V4U3 series of 0.37 kW

The bringing was performed as follows, each point of the curve for the case with turn was multiplied by the coefficient, which is the relation between the values at the point of maximum voltage value. In this case, it is a point of 750 Hz, and the definition of the coefficient is represented in equation (1).

$$k = \frac{U_{max.without\ turn}}{U_{max.with\ turn}} = \frac{7{,}75}{6{,}54} = 1{,}1 \qquad (1)$$

In this way, the maximum value of the graph for the case without a turn and curve will coincide, and it will be very clearly visible the difference between the defective and nondefective magnetic core. Similar steps were made for magnetic core, where the points of the voltage value at a frequency of 1 kHz did not match.

Curves for a non-defective magnetic core correspond to specific losses 3,92 $\frac{W}{kg}$, and with defect - 5,85 $\frac{W}{kg}$.

The graph of the voltage dependence on the frequency for the magnetic circuit of the 4A71B4У3 series of 0.75 kW is shown in Figure 3.

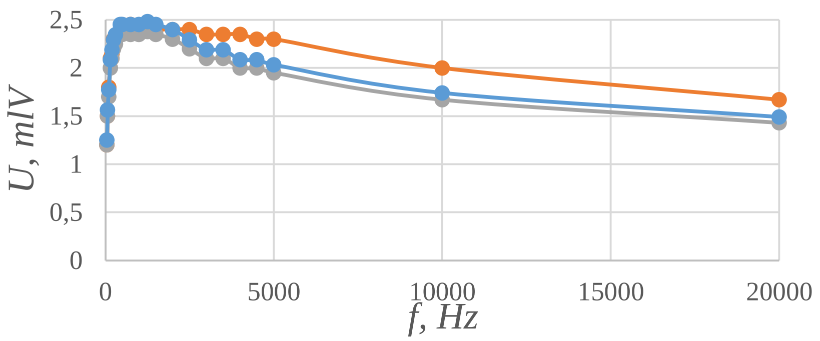

Figure 3 – The graph of the voltage dependence on the frequency for the magnetic circuit of the 4A71B4У3 series of 0.75 kW

Curves for a non-defective magnetic core correspond to specific losses 5,03 $\frac{W}{kg}$, and with defect - 6,7 $\frac{W}{kg}$.

The graph of the voltage dependence on the frequency for a part of the magnetic core of the 4A90L2U3 series of 3 kW series is shown in figure 4. In this case, it was not necessary to make the reduction, since the maximum voltage value coincides for both cases.

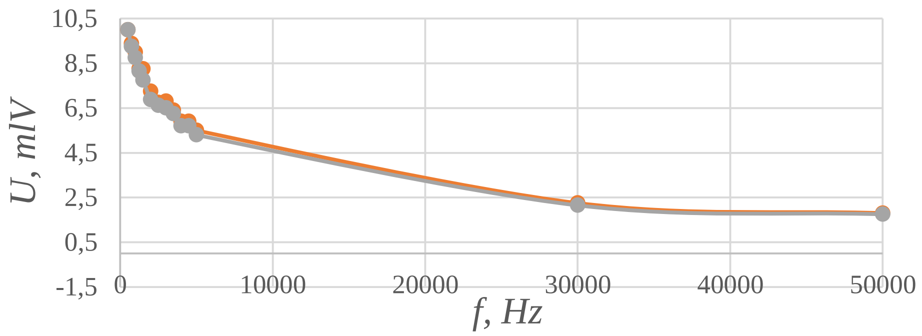

Figure 4 – The graph of the voltage dependence on the frequency for the magnetic circuit of the 4A90L2У3 series of 3 kW

Curves for a non-defective magnetic core correspond to specific losses 7,4 $\frac{W}{kg}$, and with defect - 7,85 $\frac{W}{kg}$.

The graph of the voltage dependence on the frequency for the defective part of magnetic core of the 4A90L2У3 series of 3 kW is shown in Figure 5.

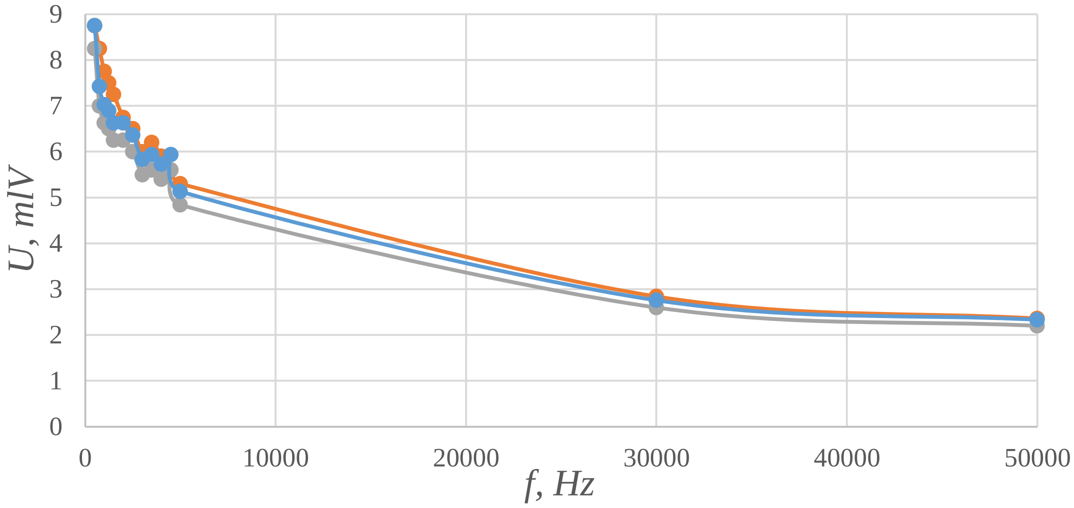

Figure 5 – The graph of the voltage dependence on the frequency for the magnetic circuit of the 4A90L2У3 series of 3 kW

Curves for a non-defective magnetic core correspond to specific losses 8,85 $\frac{W}{kg}$, and with defect - 9,15 $\frac{W}{kg}$.

Results. As can be seen from the results of the experiments, the method is confirmed in the fact that the magnetic cores with higher specific losses have less voltage value on the measuring winding. For the magnetic circuit of the 4A90L2U3 series of 3 KW series, the difference between the case without turning and with it is not entirely observable, although the results of the third magnetic core confirm the general tendency. Since this magnetic core even without a turn has a high value of losses, then its further deterioration does not affect the results so much, in comparison with other magnetic cores.

References

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