Selecting transformer sheets with the method of low-frequency impedance

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The article presented the method of low-frequency impedance applied by the Authors to control magnetic parameters of transformer sheets with the use of cheap RLC bridges and precise impedance converters. The described methods of non-destructive tests constitute a complement to the standardized control methods of transformer sheets applied by the producers and laboratory methods.

The tests were conducted for test piece from M130 steel (sheet straps) originating from five sources (from different suppliers and production batches). To identify magnetic features of these pieces the impedance measurements were taken in the area of magnetic field intensity from 1 A/m to 100 A/m by testing frequencies from 40 Hz to 2 kHz, using the 4294A precision impedance analyzer [1] and low-cost handheld RLC bridge with 5 testing frequencies. During the next stage of the test, the measurements were obtained by the use of LDC1000 converter [2] and a PCB air coil. The resonance frequency of LC tank with the influence of the object was a few MHz.

By comparing the results of measurements (frequency characteristics of magnetic permeability and loss angle δ obtained by RLC bridge with resonance bridge and impedance of a parallel LC circuit obtained by LDC1000 converter) the possibility of cheap and fast selection of transformer sheets in the weak magnetic field (using a mobile measurement path) was demonstrated. The results were verified with microstructure tests and measurements performed on professional, certified measuring positions.

On the basis of one's own research and literature recognition [3 - 6], it was concluded that the impedance measurements of the material might be used in non-destructive tests to quickly and cheaply evaluate the microstructure quality, the influence of mechanical and thermal stresses and the processes of fatigue degradation.

[1] https://www.testequipmentconnection.com/specs/HP%204294A%20SPECS.PDF

[2] http://www.ti.com/lit/ds/symlink/ldc1000.pdf.

[3] http://ndt.net.

[4] Żurek Z. H., Duka P., RLC circuits for material testing and NDT. KOMEL 2015.

[5] Agra K, Bohn F., Mori T. J. A., Corrěa M.A., DOI: 10.1016/j.jmmm.2016.06.089.

[6] Kashefi M., Rafsanjani-Abbasi A., Kehrobaee S., Alaei M., DOI: 10.1016/j.jmmm.2012.07.029.