On Measurement of Permeability of Magnetic Liquids

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Abstract **This paper contributes to the measurement of the permeability of the magnetic fluids. Measurement of ferromagnetic liquids is difficult due to their liquid state and relatively low values of magnetic permeabilities. A method for determination of magnetic properties of fluids is presented.**

Keywords **Ferromagnetic liquid, Magnetic fluid, Low permeability measurement.**

I. INTRODUCTION

Magnetic liquids represent intelligent materials with wide industrial applications (see e.g. [1,2]). Producers of magnetic liquids usually do not guarantee – and often even do not publish – the physical characteristics of magnetic fluids and designers of these devices are left on their own measurements. Most important parameters of magnetic fluids are their magnetic properties and their magneto-viscous characteristics. Measurement methods of ferromagnetic solids are described in detail, but these methods cannot be used for ferromagnetic liquids. They have the following specific magnetic properties: very low relative permeability, their hysteresis properties are negligible, and their magnetic nonlinearity manifests not until rather high magnetization values.

A method for quick industrial measurement o relative permeability of magnetic fluids was presented by authors in [3]. This method was improved to be able to measure whole magnetization curves of magnetic liquids.

II. PRINCIPLES OF MEASUREMENT

A measurement transformer was proposed - it consists of two winding, one is powered with alternating current with known shape, voltage on second is measured. Permeability can be counted from the knowledge of these two signals. Because of low values of magnetic permeability, whole transformer is immersed in the measured liquid to ensure the magnetic flux encloses trough the fluid. No other ferromagnetic objects should be present in the area of configuration during measurement.

Fig. 1. Measurement transformer without magnetic liquid

The number of turns in each winding limits the values of B/H possible to obtain by the measurement. More turns mean possibility to measure permeability under higher values of H.

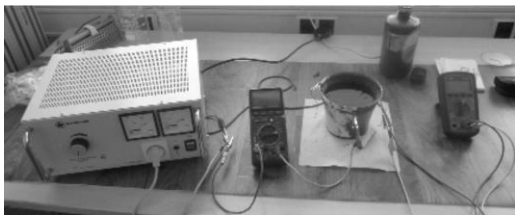

Fig. 2. Measurement arrangement

Main disadvantage of proposed measurement configuration is the amount of magnetic liquid required for each measurement.

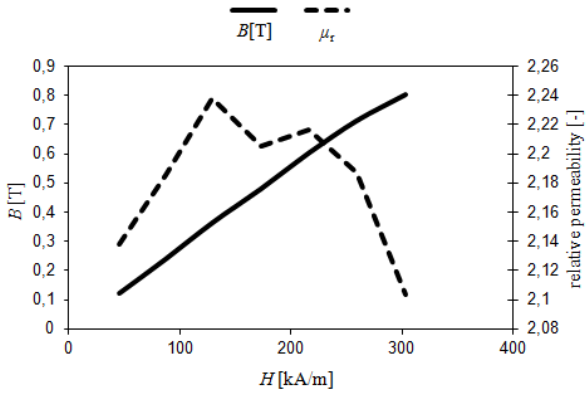

Fig. 3. Example of measured initial magnetization curve of Ferrotec EFH-1 ferrofluid

III. CONCLUSION

A method for measurement magnetization properties of liquids was presented. Magnetization curves of magnetic fluids with very low relative permeability values ($\mu_r < 2$) can be measured using this method.

IV. ACKNOWLEDGEMENTS

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V. REFERENCES

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