The numerical solutions and experimental verification of transient demagnetization of the permanent magnet

Lukas Voracek*, Bohus Ulrych*

*University of West Bohemia, Faculty of Electrical Engineering, Univerzitní 26, 30614, Pilsen, Czech Republic, e-mail: lvoracek@kte.zcu.cz

Abstract: **This paper deals with numerical solution and experimental measurement of the real electromagnet with permanent magnet. The mechanical force of the permanent magnet can be affected by the external suitable oriented magnetic field. Most often, the coil is the source of demagnetization (magnetization) field. The aim is comparison between data obtained from numerical solution and measured data.**

Keywords: **Permanent magnet, force measurement, stationary electromagnetic field, finite element method - FEM.**

I. INTRODUCTION

Demagnetization of permanent magnets is often used in many technical applications (manipulators, actuators, clamping devices, etc., See in [1]]). It means that the intensity of the magnetic field and thereby holding mechanical force of permanent magnets may be affected by some (decrease or increase) suitably oriented external magnetic field for a transitional period. The demagnetizing magnetic field is mostly created by the coil which is flowing through by the direct current.

This article compared data obtained from numerical solution and control measurement.

II. FORMULATION OF THE PROBLEM

Considered electromagnet with permanent magnet, which is distributed by company SELOS [1], is shown in Fig.1. The main part is NdFeB permanent magnet **1**, which is demagnetized by coil **2**. Both parts are in non-ferromagnetic casing **3** and insulation **4**. The ferromagnetic flange **5** is used for fixing the force measurement device.

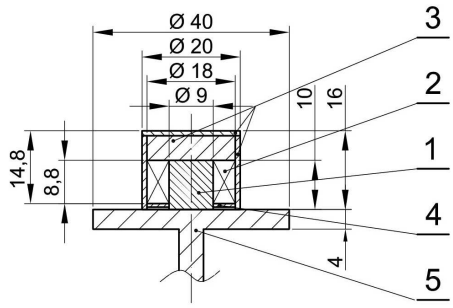

Fig. 1. Arrangement of the considered device

III. FORMULATION OF THE PROBLEM

The differential equation (1) describes the mathematical model of magnetic field in the whole electromagnet with permanent magnet [2].

$$\operatorname{curl}\left(\frac{1}{\mu}(\operatorname{curl}\boldsymbol{A}) - \boldsymbol{H}_{\mathrm{c}}\right) = \boldsymbol{J}\,. \qquad (1)$$

The corresponding vector of the electromagnetic force $\boldsymbol{F}_{\mathrm{m}}$ acting on the mover (in fact, on its ferromagnetic elements **3** and **4**) is given by the integral

$$\boldsymbol{F}_{\mathrm{m}} = \frac{1}{2}\oint_{s}[\boldsymbol{H}(\mathbf{n}\boldsymbol{B}) + \boldsymbol{B}(\mathbf{n}\boldsymbol{H}) - \mathbf{n}(\boldsymbol{H}\boldsymbol{B})]\mathrm{d}S \qquad (2)$$

The solution was carried out using the FEM based codes QuickField and Agros2D.

IV. MEASUREMENT

Electromagnet with permanent magnet, see in Fig. 2, magnetized ferromagnetic flange. Direct current passes through coil demagnetizes permanent magnet and it causes that flange fall down. Value of this current is measured in one of the measurement.

Fig. 2. The real electromagnet with permanent magnet

V. CONCLUSION

On the basis of calculation and measurement it is clear that the correct choice of input parameters can be solved tasks to achieve good agreement between numerical and experimental solution-presented demagnetization problem. Identical values of the numerical solution and the measurements will be discussed in the presentation.

VI. ACKNOWLEDGEMENTS

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VII. REFERENCES

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