FINDING THE OPTIMAL SIZE OF PERMANENT MAGNETS FOR A TRANSVERSE MAGNETIC FIELD GENERATOR WITH A DISC ROTOR

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Transverse field machines (TFM) are now very popular among the scientific community: they have a quite simple design, relatively low manufacturing cost and very efficient in various operating modes. Permanent magnets (PMs) such as Nd-Fe-B, which are used in TFM and other electrical machines, are still the most efficient, however, the price of PMs is proportional to their size and, unfortunately, is not their advantage. After all, the larger the size of the PMs, the greater the force of sticking of the magnets to the stator poles and the greater the cogging torque of the rotor during its rotation. Therefore, there is a problem of finding the optimal size of PMs without a huge loss of electromotive force (EMF) of the TFM generator and with a small cogging torque value of its rotor. That is why this is a burning question.

During this work, the research of a two-phase disk rotor TFM design was carried out. In this design U-shaped cores are fixed to the stator, and a cylinder form winding is placed into their slots. PMs with polarity in a staggered sequence are glued to the disk rotor, which is fixed between two phases of the stator [1]. The electromagnetic analysis of the machine was carried out using the Ansys Maxwell 3D software, where the properties of all magnetic conductive materials, the number of turns, and the boundary conditions were set [2]. The main sizes of the machine, the number of turns and the rotor speed were constant during the calculations, only one parameter was varied – the size of PMs. The purpose of the analysis was to reduce the size of the PMs without a significant decreasing the generated EMF, however, with a decreasing the cogging torque value of the rotor from the attraction PMs to the stator steel poles.

The width of the PMs and their length were constant (15 mm). It is necessary to maintain the stator and rotor diameter, the poles number and its size, therefore we can't change the width and the length of PMs, but only the PMs height. That is why the main parameter that was varied during the whole research – was PMs height. It was varied from 2 mm to 9 mm. At the same time, during each calculation, such parameters as the induced EMF and the cogging torque of the rotor were obtained, saved and analyzed.

After the analysis of the magnetic field with selected TFM parameters, the optimal value of the PMs height was found (3 mm), which significantly reduces the cogging torque of the rotor (68%) and satisfies the drive mechanism in torque value, and at the same time does not significantly affect the EMF value (3%) in the generator mode.

References:

1. *S. Hieke* Two-phase transverse flux machine with disc rotor for high torque low speed application / S. Hieke, M. Slamann, D. Lagunov, R. Leidhold, A. Masliennikov, A. Duniev, A. Yehorov // The 19th European Conference on Power Electronics and Applications (and Exhibition) will be held in Warsaw, Poland, 11–14 September 2017. pp. 1–8.

2. Ansys Maxwell 3D v.15 – Electromagnetic and Electromechanical Analysis: user's guide / Ansys Inc. – Pittsburgh, 2012. – 1006 p. [Електрон. ресурс]. – Режим доступу: https://www.ansys.com/.