BQ03

Demagnetization Analysis of Permanent Magnets according to Rotor Types of Interior Permanent Magnet Synchronous Motor

Ki-Chan Kim* and Ju Lee

Dept. of Electrical Engineering, Hanyang University, Seoul, 133-791, South Korea

*Corresponding author: Ki-Chan Kim, e-mail: channykim@hanyang.ac.kr

It is important to increase slot fill factor and air-gap flux density of an interior permanent magnet synchronous motor (IPMSM) in order for good performance as well as high mileage of electric vehicle. When designing a permanent magnet rotor of an IPMSM for the high air-gap flux density, it is very difficult to decide arrangement, shape, and layers of permanent magnets in a rotor [1]. Demagnetization of permanent magnet is a key design factor due to higher temperature in a vehicle. Moreover, it gives a design standard on a minimum constraint of permanent magnet volume [2], [3]. Therefore, it is necessary to design permanent magnet rotor of an IPMSM considering demagnetization. In the paper, the demagnetization characteristic according to various permanent magnet rotors such as flat type, V shaped type and double layer type is studied by using analytical method of equivalent magnetic circuit as shown fig. 1 and is analyzed with 2D FEM for the purpose of verification of results by analytical method like fig. 2. In order to analyze demagnetization effect considering material cost, we assume the total volume of permanent magnet is constant regardless of rotor types. Although it makes the thickness of permanent magnets of double layer rotor thin, we can verify that its demagnetization performance is better than V shaped rotor.

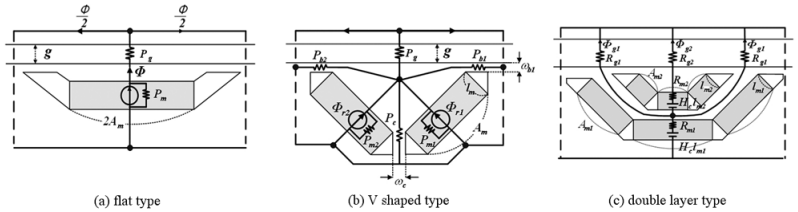

Fig. 1. Magnetic equivalent circuits for demagnetization analysis.

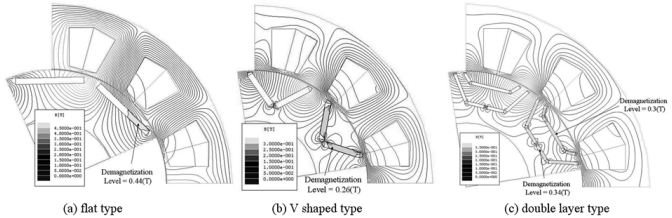

Fig. 2. Analysis results of demagnetization of permanent magnet according to rotor.

REFERENCES

[1] K. J. Lee *et al.*, Journal of Applied Physicsm, Vol. 97, No.10, 10Q505, (2005).
[2] K. C. Kim *et al.*, IEEE Trans. MAG. 42, 3485 (2006).
[3] M. Rosu *et al.*, IEEE Trans. MAG. 41, 2118 (2005).

BQ04

A Inductance Calculation Method of Synchronous Reluctance Motor Including Iron Loss and Cross Magnetic Saturation

Jong Bin Im, Kwangsoo Kim, and Ju Lee*

Dept. of Electrical Engineering, Hanyang University, 17 Haengdang-dong, Seongdong-gu, Seoul, South Korea

*Corresponding author: Ju Lee, e-mail: julee@hanyang.ac.kr

Synchronous Reluctance Motor (SynRM) has lots of advantage such as low torque ripple, vibration and noise compared with SRM. Also, it can use stator of induction motor without any design modification. Besides, it has not only hard and simple structure but also cost effective. Particularly, cost of magnet goes up three times recently, benefit of SynRM is rose. Synchronous inductances (Ld and Lq) are extremely important factor of SynRM because torque is generated by these. Therefore exact value of inductances is needed. Inductance of d- and q- axis of SynRM is varied as well as self-axis current and the other axis current because of different flux path. Cross magnetic saturation has been considered in some papers without iron loss [1]-[2]. In [1], the cross-saturation phenomenon of transverse-laminated type was analyzed by mixed theoretical and experimental approach. In [2], a simple mathematical model considering cross magnetic saturation was proposed and confirmed magnetic saturation effect of SynRM. New AC signal test method using LC resonance [3] was suggested, but it was ignored cross magnetic saturation. An approximate equation [4] for a circuit model with equivalent iron loss and cross magnetic saturation is shown. Transient characteristics of SynRM considering iron loss and cross-magnetic saturation by standstill testing method [5] are shown. In this paper, an inductance calculation method of SynRM including iron loss and cross magnetic saturation using AC signal test, equivalent circuit and saturation factor is proposed.

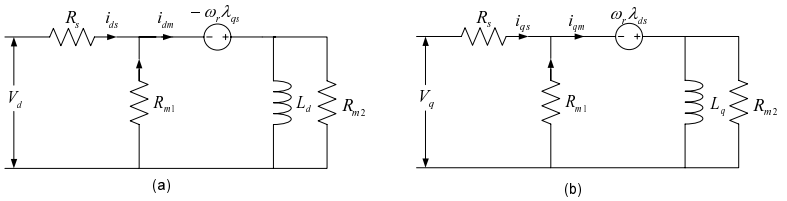

Fig. 1. Equivalent circuit of SynRM with iron losses. (a) d axis (b) q axis.

REFERENCES

[1] A. Vagati *et al.*, IEEE Trans. Ind. Appl., 36, 1039 (2000).
[2] T. Lubin *et al.*, IEEE Trans. Energy Conv., 17, 356 (2002).
[3] J. Ahn *et al.*, J. Of Appl. Phy., 99, 08R317 (2006).
[4] L. Xu *et al.*,, IEEE Tran. Ind. Appl., 27, 977 (1999).
[5] S. Yamamoto *et al.*, IEEE Trans. Ind. Appl., 43, 47 (2007).
[6] L. Pierrat *et al.*, Proc. Int. Conf. Evolution Modern Aspects Synchronous Machines, 44 (1991).