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Analysis influence stator slot opening on property multipole axial flux motor

Abstract. *This paper presents an analysis of the slot opening and the air gap area on the characteristic of the multipole axial flux permanent magnet motor. Slot opening does not have influence only on the electrical parameters. Likewise technological considerations are important, they prefer the slot opening to be larger. From the manufacturing point of view, an optimal situation is when a pole shoe does not occur. However, it has a negative impact on the parameters of the electrical machine. Based on the calculations and exemplary lab verification showed that modification of the air gap area has a significant impact on the parameters of the multipole axial flux motor.*

Keywords: axial flux motor, slot opening, multipole, motor parameters, PMSM, brushless motor.

Introduction

This paper presents an analysis of influence of the slot opening on the electrical parameters of the axial flux motor. The analysed construction is multipole one-sided. Based on the numerical calculations following characteristics were determined: static torque, induced voltage, mechanical characteristics and efficiency. Exemplary results of the laboratory tests of the two stators were presented. The stators had different slot opening. The conclusions regarding to the slot opening influence on the working point of the motor and deterioration of the efficiency were published.

Design of the motor

One quarter of the 3D model of the analysed axial flux motor is shown in the Fig. 1.

a) b)

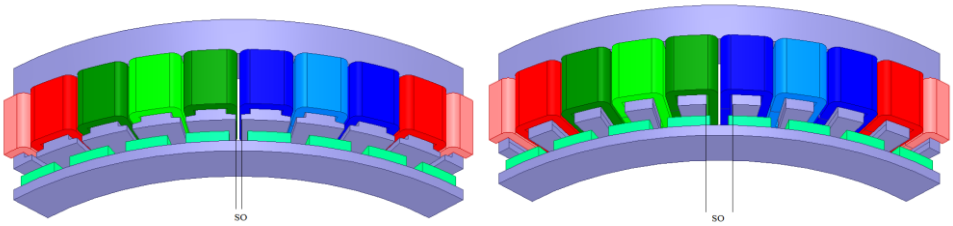
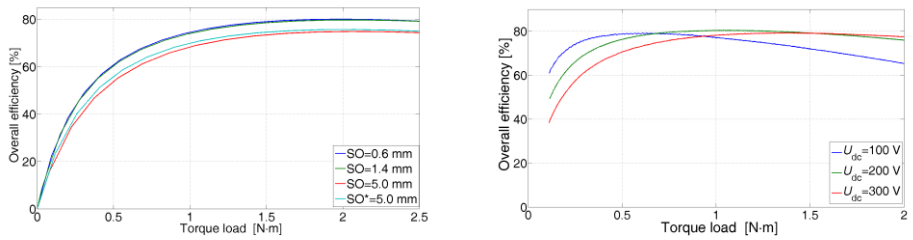


Fig.1. 3D model of the analysed axial flux motor (one quarter) a) half slot open (SO=1.4mm), b) full slot open (SO=5 mm).

The numerical calculations and laboratory tests results

Selected numerical and laboratory test results are shown in the Fig. 2.

a) b)



Rys.2. Selected tests of motor a) numerical, b) laboratory for SO=1.4 mm.

The use of the fully opened slot deteriorates torque constant, voltage constant and consequently leads to efficiency decrease.

Conclusion

The elimination of the stator pole shoes simplifies the manufacturing process. The manufacturing improvement process resulting from removal stator pole shoes has an influence on deterioration of the electrical parameters of the motor. Laboratory tests confirmed trends of modifications. Employing the full slot opening in the analysed case resulted in a reduction of efficiency by about 6% (5% - simulation, 7% - measurement). For low power applications, it might be at an acceptable level. For high power applications it is not acceptable.

References

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