Comparison of axial flux syncronous pm machines with iron and soft magnetic composite rotors

F. Marignetti, V. Delli Colli, S. Carbone

DAEIMI
University of Cassino, Cassino, Italy

Today axial flux machines attract an ever-increasing interest in various applications ranging from energy conversion to automation systems. Indeed, due to the special geometry, the Axial Flux PM Machine (AFPMM) layout makes it possible to design generation systems, handling systems and electrical vehicles with high power densities. The high number of pole-pairs, typical to AFPMM, allows them to yield better performances for low speed, direct-drive applications. In the present work a comparison is made between two AFPMM machines that share the same stator, which has been built using a Soft Magnetic Composite (SMC) type ATOMET-EM1 and whose rotors are built one with non laminated iron and the other one with the same SMC material used for the stator. SMC material allows the reduction of the eddy current losses. The stator of both machines has a three-phase concentrated fractional-slot-winding. Both rotors have 14 pole pairs and surface-mounted NdFeB permanent magnets. In order to analyze stator iron losses and rotor iron losses due to slotting, a no-load test is performed. Rotor losses are reduced by 10% using the SMC rotor, compared to the iron rotor. The AFPMM is tested as a generator on passive load using a DC motor, and the efficiency of energy conversion is obtained when the machine reaches its rated speed (1285 rpm – 300 Hz). When the load current is 7,5 A and load voltage is 75 V, the efficiency is equal to 90% in the machine with SMC rotor, compared to 70% efficiency of the machine with the iron rotor [1], as shown in Fig.1. The values of the parameters of the machines have been measured and the machines have been fully characterized. Finally, thermal tests are performed in order to investigate the steady-state temperatures. Due to its lower rotor loss, the machine with SMC rotor has a higher rating.

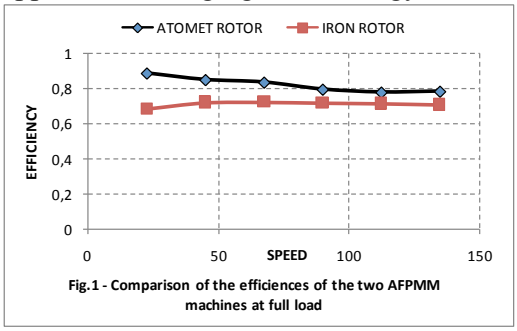

Fig.1 - Comparison of the efficiences of the two AFPMM machines at full load

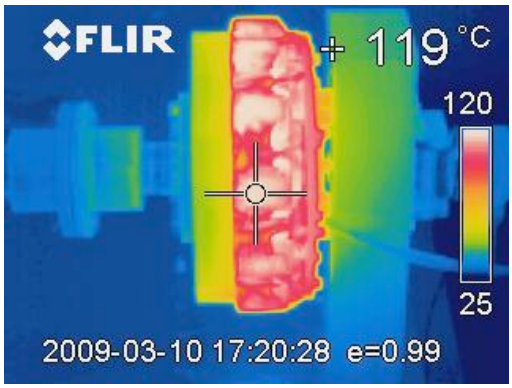

Fig.2 – Thermal picture of the machine with SMC rotor at full load.

[1] F. Marignetti, *Member IEEE* , V. Delli Colli, R. Di Stefano, A. Cavagnino, *Member IEEE* , "Design Issues of a Fractional-Slot Windings Axial Flux PM Machine with Soft Magnetic Compound Stator" Nov. 5-8,2007

Corresponding author e-mail: silvio_carbone@libero.it