Thermal compensation model of magnetic circuits with modern magnetic materials

T. Szumiata[1] and M. Gzik-Szumiata[1]

[1] *Department of Physics, University of Technology and Humanities in Radom, Krasickiego 54, 26-600 Radom, Poland*

In this work a quantitative analysis of thermal compensation has been performed for a magnetic circuit producing magnetic field in the air gap. The considered system consisted of Sm_2Co_{17} type permanent magnet (as a source of magnetic field), nanocrystalline FINEMET alloy (as ultra-soft magnetic medium) and Fe-Ni low Curie temperature compensative material with approx. 30% nickel (as magnetic shunt). A distribution of magnetic field induction in the circuit was calculated numerically within standard one-dimensional approximation, however nonlinearities of magnetic characteristics of compensative material have been taken into account as well as demagnetization susceptibility of permanent magnet. As a result of the optimization procedure a thermal stability of magnetic field in the air gap appeared to be 10 times better than the stability of permanent magnet remanence, which was achieved by appropriate choice of the compensative element thickness. The improvement was reached at the expense of the only 1% loss of the magnetic field compared to the case without compensative shunt. An effective thermal compensation of magnetic circuits is crucial e.g. in construction of electric energy meters and tachometers.