Measurement of the DC properties of permanent magnets using a Pulsed Field Magnetometer.

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In the design of electric motors that use NdFeB magnets the intrinsic coercivity exhibited determines the maximum operating temperature that can be used. A convenient method for measuring this quantity and the changes exhibited with temperature is Pulsed Field Magnetometry (PFM). The pulsed magnetic field applied to the magnet allows the full BH curve to be measured in milliseconds. This is important since when determining the DC properties of permanent magnets, the increase in the magnetic field necessary for reversal of polarization should be performed quasi statically to avoid introducing dynamic errors such as magnetic viscosity. The measured intrinsic coercivity is known to increase when the polarization reversal time (PRT), the time taken to reduce polarization from 90% to zero, is below a material dependent threshold.

Since industrial measurement systems require a high throughput of measurements, the errors that dynamic measurements, such as the PFM, introduce need to be evaluated. In this paper a detailed study is reported on magnets with intrinsic coercivities ranging from 640 kA/m to 2000 kA/m, measured using a National Measurement Institute grade electromagnetic system. For each magnet a PRT between 2 to 600 seconds was used. The dependence of the measured intrinsic coercivity on the PRT was analysed using published models and a method for correcting the dynamically measured values from a PFM to obtain the required DC value is presented. This work shows that an electromagnet measurement of DC intrinsic coercivity, where the PRT is too short, cannot be used to calibrate the PFM. The effect of saturating the electromagnet's yokes on the measured demagnetization curve will also be presented, which despite producing unphysical reversal behaviour, is shown to still yield the correct intrinsic coercivity.