MEASUREMENTS OF MAGNETIC FIELDS - II

Background

The magnetic field B, created inside a coil of N turns and length ℓ through which an electric current I flows, is calculated by the equation

$$B = \frac{\mu N I}{l}$$

where μ is the magnetic permeability of the medium (in air, using International System of Units, it is $1{,}26 \times 10^{-6}$).

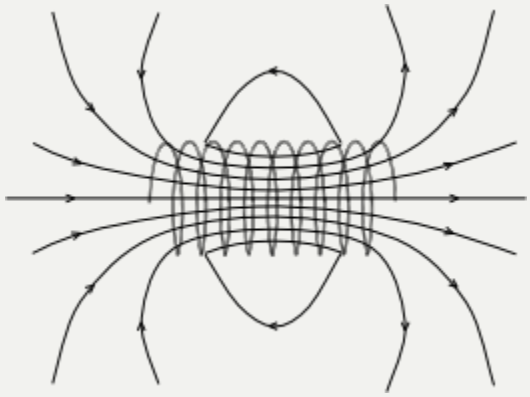

Figure 1. Magnetic field lines created by a coil

In Figure 1, which represent magnetic field lines, it is shown that the intensity of the magnetic field (proportional to the density of lines) does not remain constant in the interior but it decreases slowly from the center to the edge of the coil. Actually, equation 1 provides the field at the center of the coil with an error less than 1% whenever the length of the coil is at least 10 times the diameter. When this condition is not accomplished, equation (1) is modified by a correction factor

$$B = \frac{\mu N I}{l} \frac{l}{\sqrt{l^2 + D^2}} = \frac{\mu N I}{\sqrt{l^2 + D^2}}$$

where D stands for the coil diameter. The magnetic field of a coil is similar to a magnet and, therefore, its ends are equivalent to a north or south pole, depending on the direction of current. As shown in Figure 2, the end where the current rotates couter-clockwise has an outflow (north pole) and the end where the current rotates clockwise have a inflow (south pole). See also right-hand rule. A simple way to determine the poles consists of writing on the endfaces of the coil the of the letters N and S. The pole is that one in which arrows at the ends of the letter coincides with the direction of the current.

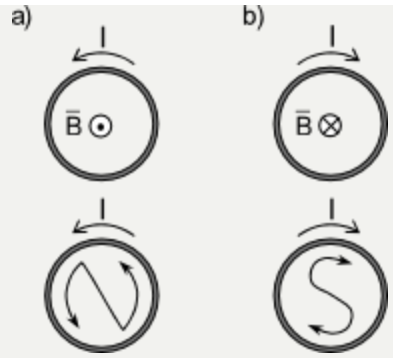

Figure 2. The direction of the field on the faces of a coil and the poles a) north and b) south.

If the magnetic field created by the coil is superimposed onto another one, in example the horizontal component of the Earth's magnetic field, the resultant field will be in the form shown in Figure 3, where the coil axis is arranged perpendicular to the field of the environment and the current flowing through the coil is being increased.

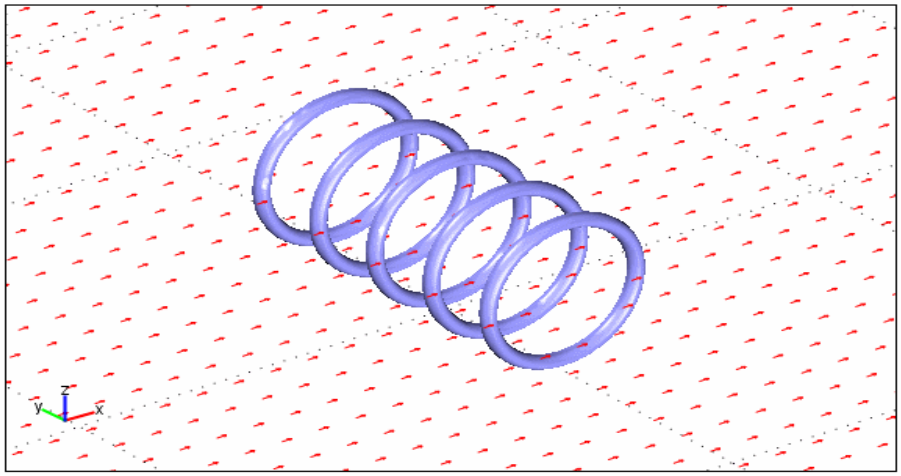

Figure 3. Variation of resultant magnetic field with the electric current

Source: http://web.ua.es/docivis/magnet/background.html