4.4.3 Ceramic-Magnets (Hard Ferrites)

At the beginning of the fifties a new magnetic material was introduced, which is based on the crystal anisotropy of **barium oxide**. This kind of magnet is called a ferrite, oxide or ceramic magnet. Nowadays, mainly **barium ferrite** and **strontium ferrite** are employed. They can be manufactured more cheaply than Alnico-magnets and achieve much higher coercive field strengths, but smaller remanence values.

Ceramic magnets run through a powder-metallurgy production process and their magnetic data can be tuned to a large extent. Their remanence is relatively small at 0.2 – 0.4 T, whereas a coercive field strength of more than 200 kA/m can be achieved. The maximum energy density, of up to 36 kJ/m³, is also much higher than for the Alnico magnets. In contrast to the (comparatively long) Alnico-magnets, a typical ceramic-magnet is relatively short: the optimum length/diameter ratio is close to two. This is the reason why it is employed in (cheap) pickups as a bar magnet beneath the coil, nearly never as cylinder magnet within the coil; for that application the geometry would be too unfavorable.

The relative **permeability** of ceramic magnets does not differ much from 1 and, thus, the inductance of the coil is not increased much, even if the magnet is mounted inside the coil. In contrast to Alnico magnets, ceramic magnets are insulators unable to produce eddy currents. As a result, there is no eddy current dampening of the coil. However, if the field of the underlying ferrite magnet is directed through the coil by iron rods, the eddy current losses are higher as in the case of Alnico cylinder magnet pickups.

Even stronger magnets can be produced with cobalt/neodymium or cobalt/samarium with maximum coercive field strengths of more than 2000 kA/m. These rare-earth-magnets are very expensive – and for pickups only useful in “homeopathic” quantities.

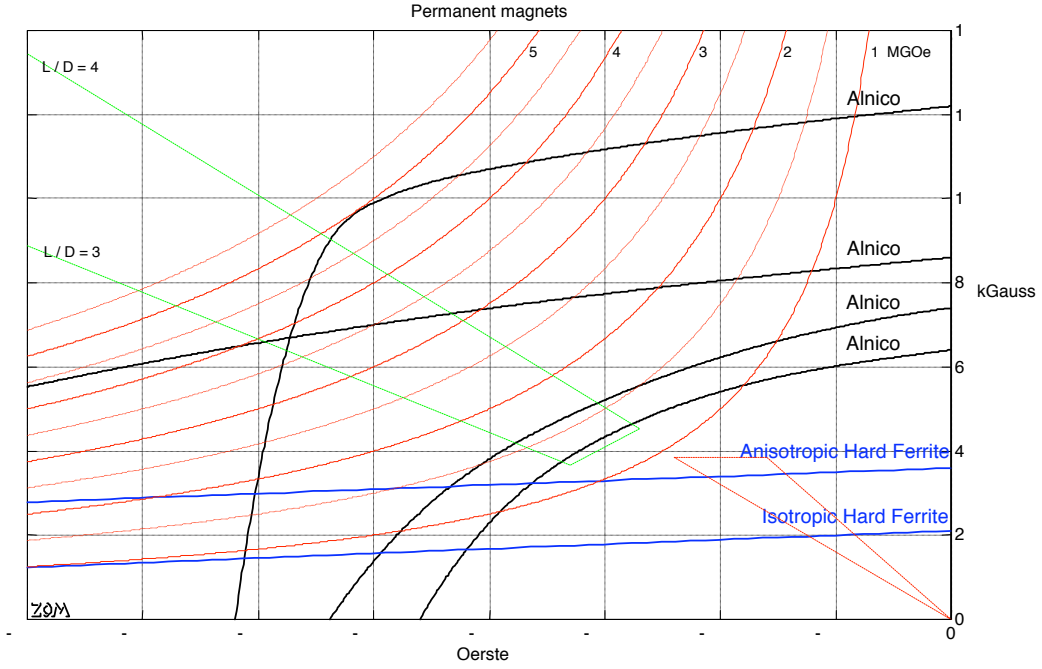

Fig. 4.12: Comparison of Alnico- und Ferrite-magnets. The load curves (different for Alnico and Ferrite) specify the length/diameter ratio of cylindrical magnets (chapter 4.6).