CERAMIC MAGNETS

Ferrite is a ceramic material made by mixing and firing large proportions of iron (III) oxide (Fe_2O_3, rust) blended with small ons of strontium carbonate, in fact one or more additional metallic elements, such as barium, manganese, nickel and zinc. Ferrites are produced by heating a mixture of the oxides of the constituent metals at high temperatures. In some cases, the mixture of finely-powdered precursors is pressed into a mold. For barium and strontium ferrites, these metals typically supplied as their carbonates, $BaCO_3$ or $SrCO_3$. The resulting mixture of oxides undergoes sintering.

They are both electrically non-conductive, meaning that they are insulators, and ferrimagnetic, meaning they can easily be magnetized or attracted to a magnet. Ferrites can be divided into two families based on their resistance to being demagnetized (magnetic coercivity). Hard ferrites have high coercivity, so are difficult to demagnetize.. Soft ferrites have low coercivity, so they easily change their magnetization and act as conductors of magnetic fields. They are used in the electronics industry to make efficient magnetic cores called ferrite cores for high - frequency inductors and transformers, and in various microwave components.

Ceramic (ferrite) permanent magnets usually appear in the forms of discs, rings, blocks, cylinders, and sometimes arcs for motors. Most ceramic magnets, sometimes known as ferric magnets, aren't particularly strong. Alnico magnets are made from aluminum, nickel and cobalt. They're stronger than ceramic magnets, but not as strong as the ones that incorporate a class of elements known as rare-earth metals.

Attributes of Ceramic Magnets

- High intrinsic coercive force
- Finishing requires diamond cutting or grinding wheel / Tooling is expensive / Limited to simple shapes due to manufacturing process
- Least expensive material compared to alnico and rare earth magnets
- Lower service temperature than alnico, greater than rare earth
- Lower energy product than alnico and rare earth magnets
- Grade 8 is the strongest ceramic material available

Applications of Ceramic Magnets

They are used to make permanent magnets for applications such as refrigerator magnets, loudspeakers, and small electric motors and further in magnetic resonance imaging (MRI), magnetos used on lawnmowers and outboard motors, DC permanent magnet motors (used in cars), separators (separate ferrous material from non-ferrous), used in magnetic assemblies designed for lifting, holding, retrieving, and separating.

Typical Magnetic and Physical Properties of Ceramic Magnet Material

Magnetic Materials	Density		Maximum Energy Product BH (max)	Residual Induction Br	Coercive Force Hc	Intrinsic Coercive Force Hc	Normal Maximum Operating Temp.	Curie Temp.
	lbs/in	g/cm	MGO	Gauss	Oersteds	Iersteds	C°	C°
Ceramic 1	0.177	4.9	1.05	2300	1860	3250	450	450
Ceramic 5	0.177	4.9	3.4	3800	2400	2500	450	450
Ceramic 8	0.177	4.9	3.5	3850	2950	3050	450	450