Ceramic Material Properties

CERAMIC

Ferrite magnets, sometimes referred to as ceramic because of their production process, are the least expensive class of permanent magnet materials. This material became commercially available in the mid 1950s, and has since found its way into countless applications including arc shaped magnets for motors, magnetic chucks, and magnetic tools.

MAGNET SELECTION

Ceramic magnets are inherently brittle, and it is highly recommended that they NOT be utilized as structural elements in any application. Their thermal stability is the poorest of all the magnetic families, but they may be utilized in environments up to 300 °C (570 °F). The dimensional repeatability of as pressed components is difficult to control, consequently, components requiring tight tolerances necessitate secondary grinding operations to assure conformity.

CERAMIC PRODUCTION

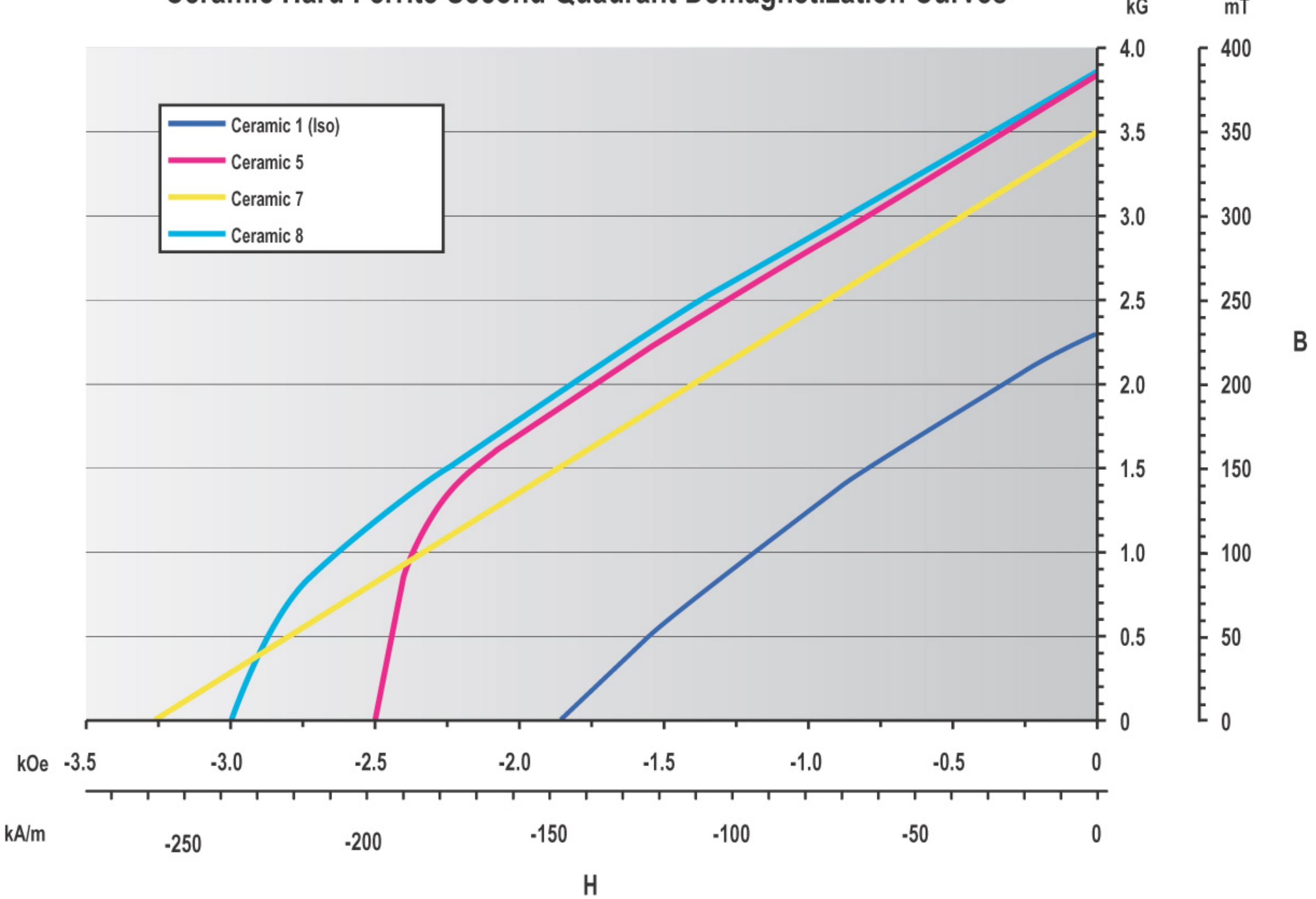
The raw material, iron oxide, for these magnets is mixed with either strontium or barium and milled down to a fine powdered form. The powder is then mixed with a ceramic binder and magnets are produced through a compression or extrusion molding technique that is followed by a sintering process. The nature of the manufacturing process results in a product that frequently contains imperfections such as cracks, porosity, chips, etc. Fortunately, these imperfections rarely interfere with a magnet's performance.

To enhance a ceramic magnet's performance, the ferrite compound may be biased by a magnetic field during the pressing process. This biasing induces a preferred direction of magnetization within the magnet, significantly reducing its performance in any other orientation. Consequently, ceramic magnets are available in both oriented (anisotropic) and non-oriented (isotropic) grades. Because of its lower magnetic properties, the isotropic grade of ferrite, ceramic 1, is typically utilized where complex magnetization patterns are required, and in process biasing would be cost prohibitive.

	Composition	**Magnetic Properties**							
	[M = Ba, Sr or a mixture of the two elements].	Max Energy Product **BH_{max}**		Residual Induction **B_r**		Coercivity H_c		Intrinsic Coercivity **H_{ci}**	
Material Grade		(MGOe)	(kJ/m^3)	(kG)	(mT)	(kOe)	(kA/m)	(kOe)	(kA/m)
Ceramic 1	$MO \cdot 6Fe_2O_3$	1.05	8.35	2.30	230	1.86	150	3.25	260
Ceramic 5	$MO \cdot 6Fe_2O_3$	3.40	27.1	3.80	380	2.40	190	2.50	200
Ceramic 7	$MO \cdot 6Fe_2O_3$	2.75	21.9	3.40	340	3.25	260	4.00	320
Ceramic 8	$MO \cdot 6Fe_2O_3$	3.50	27.8	3.85	385	2.95	235	3.05	245

Material Grade	Density		Tensile Strength		Transverse Modulus of Rupture		Moh Scale Hardness	Coefficient of Thermal Expansion //	Electrical Resistivity	Curie Temperature		Max Service Temperature	
	lb/in^3	g/cm^3	kpsi	MPa	kpsi	MPa		10^{-6} / °C	Ω-cm x 10^6	°C	°F	°C	°F
Ceramic 1	0.177	4.9	4.0	27	9.0	62	7	14	> 1	450	842	250	480
Ceramic 5	0.177	4.9	4.0	27	9.0	62	7	14	> 1	450	842	250	480
Ceramic 7	0.172	4.8	4.0	27	9.0	62	7	14	> 1	450	842	250	480
Ceramic 8	0.177	4.9	4.0	27	9.0	62	7	14	> 1	450	842	250	480

Ceramic Hard Ferrite Second Quadrant Demagnetization Curves



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