

High performance graphite for extreme applications

Pyrolytic graphite is a form of graphite with enhanced thermal, mechanical and electrical properties which make it well suited for forming and shaping tools. In some situations it is already replacing traditional graphite materials.

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Pyrolytic graphite is manufactured and sold as Pyroid by Minteq International, a leading refractories supplier to the glass industry. The material has proven to be a high quality hot glass contact material and is finding use in applications where extremes of temperature and product quality concerns make better and more reliable materials a priority.

Minteq has been making Pyroid pyrolytic graphite for some time but to date it has only been used in highly specialized applications. These include the manufacture of plasma etching electrodes and ion grids for the electronics industry and the manufacture of rocket nozzles in the aerospace industry. Its utility as a 'glass friendly'

handling material is based on its superior strength to normal graphite materials and its non-wetting surface properties. Its performance has been proven in its use in forming tools and dies for shaping glass. In the tableware, container and specialty glassmaking businesses it is taking the place of traditional graphite materials in drop plates, deflector shields and other contact applications because of its durability and high thermal performance.

Because of its resistance to thermal shock, it can also be used for support pads to isolate unannealed glass, preventing localized cooling and minimizing checking due to thermal stress. In addition, in glass processing applications, pyrolytic graphite does not shed particles nor does it mar the surface of hot glass, suggesting applications for glass bending and tempering.

Anisotropic properties

Traditional graphites are formed from resins and particles that are molded hydraulically or isostatically, then baked to bond the raw materials. Finally, they are post-treated to enhance specific material properties. By contrast, pyrolytic graphite is pure polycrystalline graphite with no binders formed by chemical vapor deposition (CVD) at temperatures in excess of 2000°C.

Typical molded graphite composition consists of very structured, repetitively-stacked layers. The layers found in pyrolytic graphite are randomly-stacked. This 'anisotropic' randomly stacked-structure of the basal planes in pyrolytic graphite accounts for the difference in its properties as a function of the direction in which measurements are made.

	Direction		
Flexural strength	room temperature	a	kg/cm ² 840
	2750°C	a	kg/cm ² 3500
Compressive strength	Room temperature	a	kg/cm ² 1050
		c	kg/cm ² 2500
Coefficient of thermal expansion	Room temperature	a	10-6/°C 0.1
		a	10-6/°C 1.5
	2200°C	c	10-6/°C 2
		c	10-6/°C 20
Thermal conductivity	20-1000°C	a	W/m ² K 304
		c	W/m ² K 1.73
Permeability	Helium leak tight at 10 ⁻⁶ mmHg		
Scleroscope hardness	a		103
	c		83

Table I. Physical properties of continuously nucleated (CN) pyrolytic graphite.