

Impervite® graphite the big advantage



Impervite® brand impervious graphite is a composite material consisting of a graphite base material impregnated with a proprietary phenolic resin using a well-controlled process. Impervite® impervious graphite heat exchangers are ideally suited for processes involving the heating or cooling, condensing, and evaporating of sulfuric acid, hydrochloric acid, phosphoric acid, nitric acid, mixed acids, chlorinated hydrocarbons and many other highly corrosive fluids.

The base graphite is selected for optimum physical properties to maximize penetration depth of our phenolic resin impregnation, resulting in optimum Impervite® properties. When choosing raw graphite, the critical properties we consider are grain size, grain distribution, percent of voids, strength and thermal conductivity. All of these properties are important to ensure a final product that meets our high expectations and quality standards.

It is interesting to note that carbon and graphite are produced using the same process - the difference is that the carbonization process is terminated at about 840°C (1550°F) where graphitizing requires typical temperatures in excess of 2600°C (4600°F). Since they are different phases of the same material, the physical and thermal properties of carbon and graphite are different: carbon has higher initial strength properties but is more of an insulator and is less tough; graphite is less brittle and has higher thermal conductivity. CG Thermal supplies fully graphitized tubes which are the industry leader in regards to thermal shock resistance and fatigue life.

	IMPERVITE®	Brand M
CONDUCTIVITY (W/Mk)	100	64
TENSILE STRENGTH (Mpa)	28	29
CTE (x 10 ⁻⁶ /C)	1.88	3.1
YOUNG'S MODULUS (Gpa) (-10)	158	150
THERMAL SHOCK RESISTANCE	9	4

1. Thermal Shock resistance = $\frac{\text{Conductivity} \cdot \text{Tensile Strength}}{\text{CTE} \cdot \text{Young's modulus}}$

2. "Brand M" properties are from published values.

The resin specified by CG Thermal to produce Impervite® has properties that are field-proven to match specifically with the base graphite properties and our impregnation process. This resin consists of a phenolic compound, solvent and carrying fluids. The viscosity and miscibility of the resin are controlled to insure a consistent and reliable impregnation process.

Impervite® is produced using a four step impregnation process that, depending upon the geometry of the graphite being treated, can be repetitive:

1. The graphite is heated to drive off moisture and contamination.
2. The graphite is subjected to a high vacuum to remove air from the voids then flood them with the resin
3. The tank is then subjected to high pressure to force the resin into the voids, maximizing graphite penetration depth.
4. The resin in the graphite is polymerized to the desired hardness using controlled heating.

The rate of polymerization is closely controlled and monitored because if the process is performed too quickly or too slowly the graphite will not be fully impregnated, and porosity or micro-cracks can result. Impregnation records are filed as a quality assurance policy.

By carefully measuring the resin properties and matching the characteristics of the graphite, we can guarantee a final product that consistently meets our mechanical, thermal and corrosion resistant standards. Impervite® graphite heat exchangers meet or exceed all other phenolic impregnated graphite in thermal conductivity, thermal efficiency and corrosion resistance.

In those rare cases of corrosive applications where either the impregnation resin and/or the graphite base is questionable in regards to corrosion resistance our Umax® Advanced Ceramic heat exchanger is the ideal solution, offering features and benefits not found in any other heat exchanger. *Details can be found on page 7 of this bulletin.*