

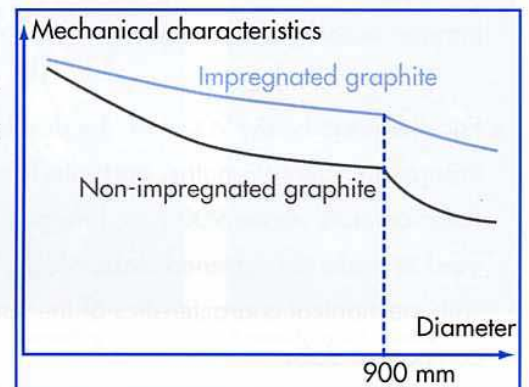
WHY REINFORCE GRAPHITE?

A SPECIFIC PROBLEM IN CERTAIN PROCESSES

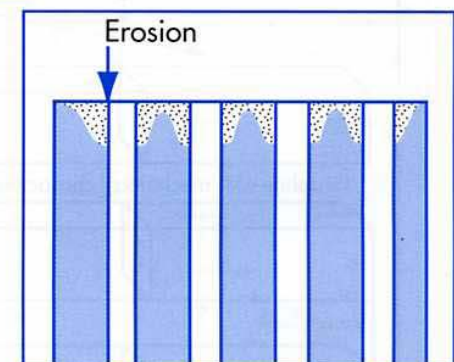
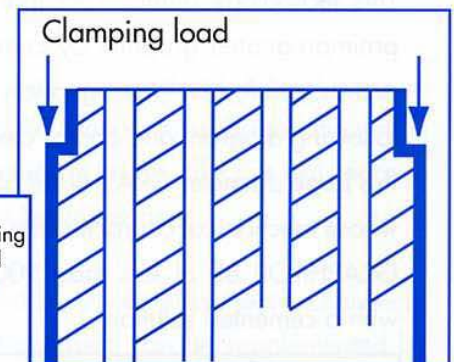
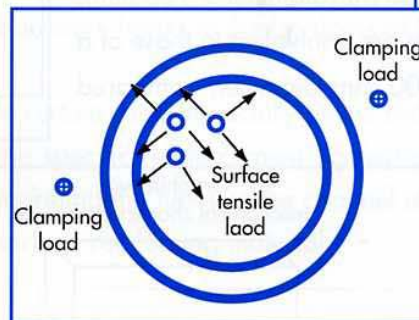
In spite of the excellent mechanical performance of the various GRAPHILOR materials, problems of cracking and/or erosion are sometimes encountered in certain specific uses of appliances.

CRACKING

- The mechanical strength of impregnated graphite diminishes as parts get larger (see graph opposite). Certain processes require large-sized appliances.



- Impregnated graphite is a ceramic material which displays quite specific mechanical behaviour: it is preferable to minimize the tensile loads in the appliance. The photoelastic-metric study shows that the compression loads used to clamp the stack of end blocks or plates of tubular heat exchangers develop tensile loads on the surface of the block or plate which can in the long term lead to cracking between the process holes.



EROSION

- The fact that the process uses fast-flowing fluids laden with abrasive particles causes abrasion at the surface of the inlet blocks or plates of tubular heat exchangers

THE CARBONE LORRAINE SOLUTIONS: REINFORCED COMPOSITE GRAPHILOR 3 MATERIALS

CARBONE LORRAINE has developed a reinforced composite material to avoid cracking and corrosion.

The resulting composite material takes the form of a solid piece of graphite and impregnated carbon which, thanks to the treatments it has undergone, is fully resistant to temperature and corrosion.

How can cracking be prevented

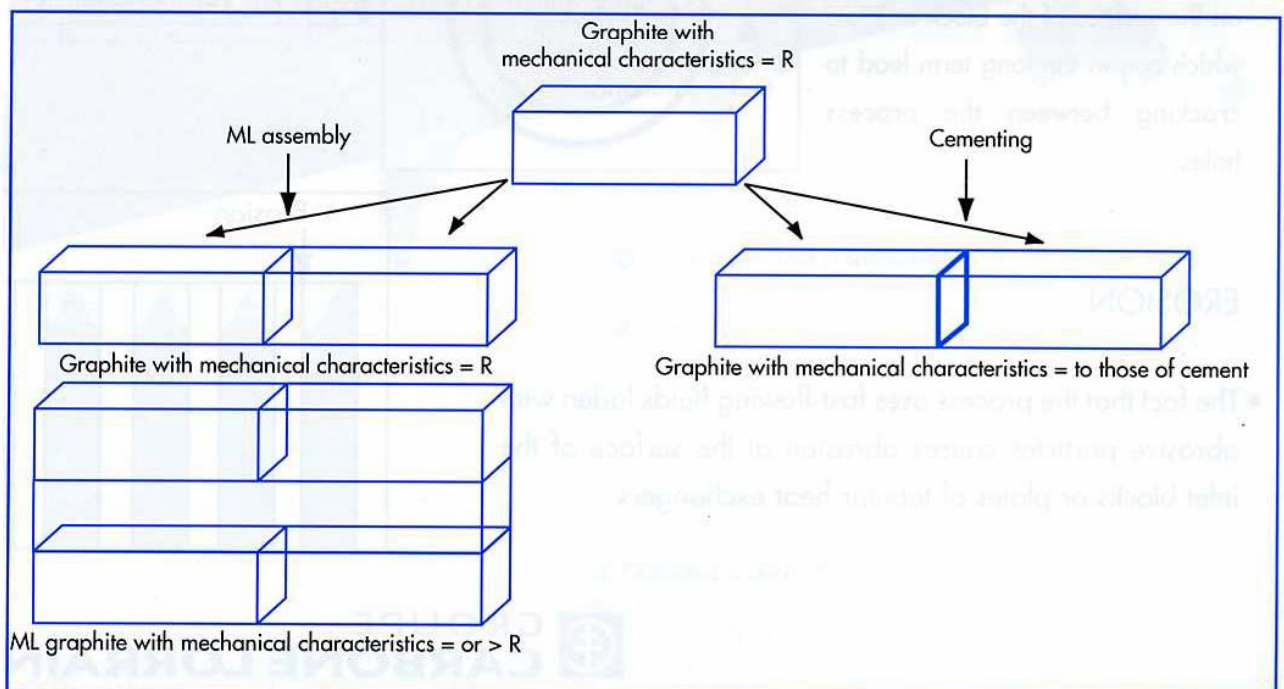
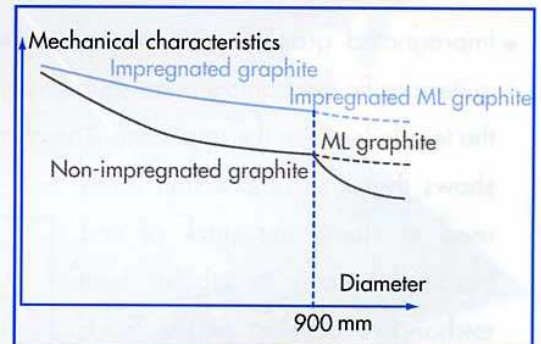
The two causes of cracking are solved in the following manner:

Intrinsic material characteristics:

- For diameters below 900 mm, the development of fine-grain graphite with high mechanical characteristics ensures sufficient strengths, particularly tensile strength, to prevent cracking.

For diameters above 900 mm, fine-grain graphite with high mechanical strength (small cross-section) are used to make straightened slabs which, when judiciously assembled, give a material of large dimensions with mechanical characteristics of the same level as the small-section fine-grain graphite used to make the component slabs.

This technology differs from that used for the assembly of preimpregnated graphite by cementing, because the slabs are assembled by impregnation of the graphite mass. The following diagram and photos clearly show the advantage of this large diameter GRAPHILOR BS ML (diameter > 900 mm), whose mechanical characteristics are equivalent to those of a GRAPHILOR BS of less than 900 mm diameter, compared with a cemented solution.



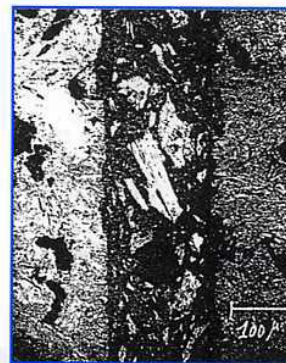
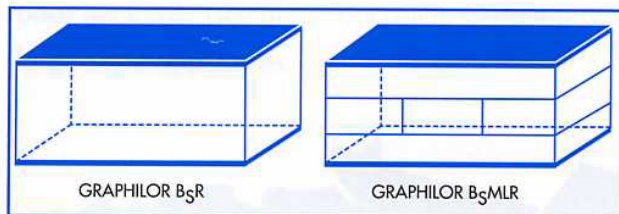
- Reinforcing GRAPHILOR against the surface tensile load on the surfaces of parts

The composite material made up of graphite slabs with high mechanical characteristics is sandwiched between two layers of carbon fibre (a few millimetres thick) which, once impregnated, gives a monolithic carbon composite material.

The tensile strength of the fibrous composite fabric exceeds 1000 kg/cm², thereby ensuring perfect resistance to the surface tensile loads generated by the clamping of the appliances.

As was indicated earlier, this is a homogeneous assembly: carbon + resin.

Tests performed by overtightening blocks have demonstrated, as confirms the VERITAS certificate below, that the reinforced blocks withstand clamping loads of the order of 45,000 daN compared with 29,000 daN for the same non-reinforced blocks

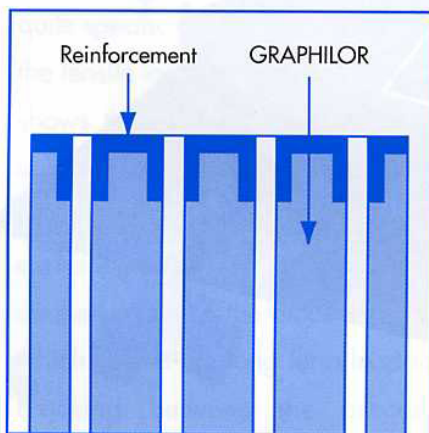


Assembly by cementing



Assembly by ML «plates»

- How to prevent erosion



The laying up of impregnated carbon fibres on the surface of parts on the process side not only provides the strength to withstand the tensile loads generated at the surface, but also ensures effective resistance to abrasion thanks to the hardness of the material.

In certain cases (especially on the end plates of tubular heat exchangers), the specific reinforcement against abrasion can be supplemented by jacketing the tubes at the channel inlet with a material identical to the surface reinforcing material.

The excellent results obtained in over 10 years of in-service experience with the BS R, BS ML, BS ML R materials in block and tubular heat exchangers confirms their unsurpassed characteristics.

Bureau Veritas
Branche Industrie

ATTESTATION
MTZ 4 89 006

Le soussigné: C. CORRE
The undersigned

du BUREAU VERITAS, agissant dans le cadre des conditions générales de la Branche Industrie
from BUREAU VERITAS, acting within the scope of the general conditions of the Industrial Branch

(inventorises ou verso), certifie avoir assisté, le 20 janvier 1989, à des ESSAIS DESTRUCTIFS DE BLOCS
EN GRAPHITE Type 261 P

DEMANDEUR: LE CARBONE-LORRAINE - FAGNY-SUR-MOSELLE

COMMANDE: 010199 du 9 janvier 1989

1-Avant exécution des essais, la presse marquée DARRAGON N° 34 015 a été vérifiée à l'aide d'une poutre de contrôle marquée LEBOW N° 2701 Force 60000 daN - aucune anormale.

2-Les blocs ont été soumis à un effort de compression jusqu'à fissuration.
Les résultats des essais sont mentionnés ci-après.

à) Blocs renforcés sur 2 faces

N°	Rupture en bars	Rupture en daN
1	175	44 598
2	198	52 945
3	155	41 061
4	160	42 465

Bureau Veritas Branche Industrie	SUITE A CONTINUED TO	ATTESTATION	N°:	Page
BV - MTZ 4 89 006			Date: 24.01.1989	1/2

Blocs non renforcés	
Rupture en bars	Rupture en daN
110	29 388
118	31 445
112	29 902
102	27 330

Blocs renforcés sur 2 faces	
Rupture en bars	Rupture en daN
110	29 388

BUREAU VERITAS
LE CHIEF DE SERVICE

1989

SPECIALISTE MONDIAL
de composants pour
l'industrie

Dès l'origine, 1892, CARBONE LORRAINE affirme sa vocation internationale en créant des filiales sur tous les continents.

Aujourd'hui, avec des établissements industriels et commerciaux dans plus de 30 pays, des agences et représentations dans plus de 70 pays et 250 contacts commerciaux répartis dans le monde entier, CARBONE LORRAINE donne à sa clientèle l'assurance de trouver partout des produits fiables, de haut niveau technologique et le service d'assistance de ses techniciens expérimentés.

WORLDWIDE SPECIALIST
in industrial
components

Since its foundation in 1892, CARBONE LORRAINE has built up an international reputation by creating subsidiaries on all continents.

Today with industrial and commercial plants scattered in more than 30 countries, agencies and representatives in more than 70 countries and 250 commercial contacts throughout the world, CARBONE LORRAINE offers its customers everywhere reliable high technology products and the service of its experienced technicians.

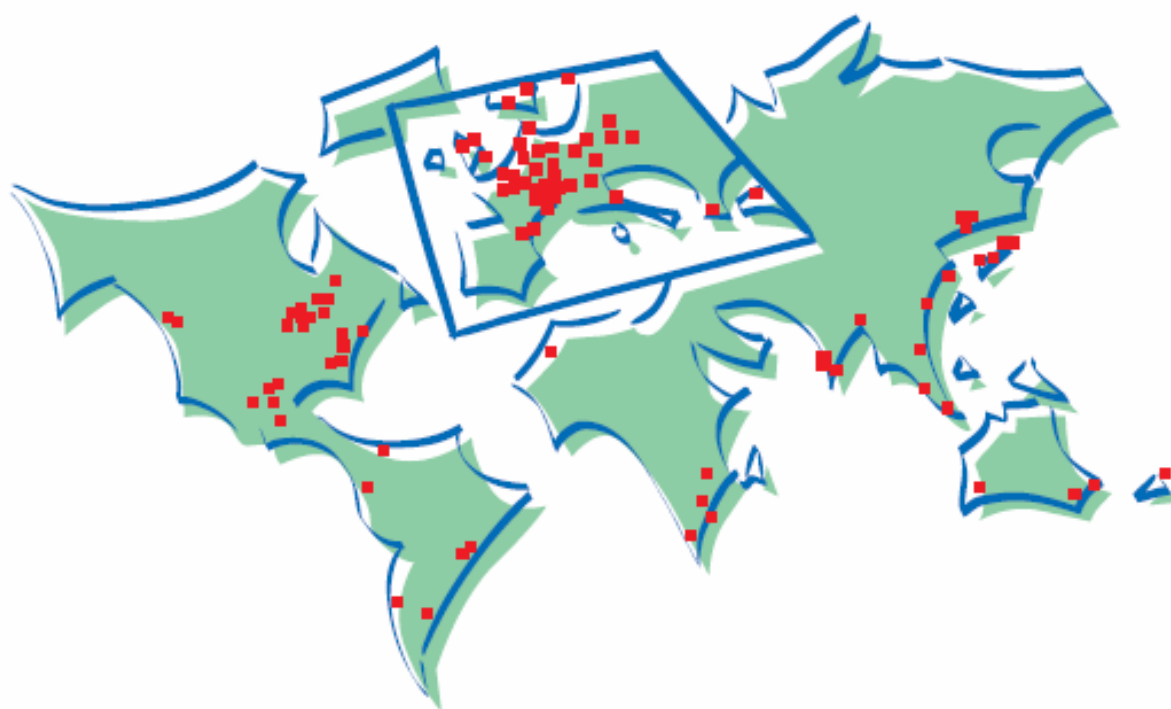
**INTERNATIONALER
SPEZIALIST**
für Industriebauteile

Die Gründung von Tochtergesellschaften auf allen Kontinenten ist Bestandteil der Politik von CARBONE LORRAINE seit dem Beginn der Firmengeschichte im Jahre 1892. Heute, mit Produktions- und Vertriebsniederlassungen in mehr als 30 Ländern, Agenturen und Vertretungen in mehr als 70 Ländern und 250 Ankaufstellen für Kunden in der ganzen Welt, sichert CARBONE LORRAINE ihren Kunden überall auf der Welt zuverlässige Produkte mit hohem technischen Niveau sowie den Kundendienst erfahrener Techniker zu.

Une présence internationale

A worldwide organization

Weltweite Präsenz



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