# ANTIOXIDANTS FOR CARBON-BONDED REFRACTORIES

Carbon in refractory materials improves thermal shock resistance, protects against wetting from metals and slag, and requires extra protection from oxidation. Carbon bonded refractories have the best chemical resistance against molten steel. However they are sensitive to oxidation.

Grains and powders

Zirconium diboride – $ZrB_2$ 1-3 mm

## Application

Metallic additives are very common but ceramic antioxidants (boron carbide, calcium hexaboride and zirconium diboride) are proven more effective.

When TETRABOR® Boron Carbide is oxidized, an interaction occurs with the matrix material to form liquid and/or gaseous phases protecting the carbon from oxidation, thereby prolonging the service life of carbon-bonded refractory materials.

Calcium hexaboride is primarily used for carbon-bonded MgO based bricks and monolithics in the steel making processes.

Zirconium diboride is the best additive for improving corrosion resistance in zirconia based carbon-bonded refractories coming into contact with ferrous melts, e.g. submerged entry nozzles.

## Chemistry (typical values)

| | |
|---|---|
| $B_4C$ | |
| B + C | > 95 % |
| $C_{free}$ | < 4 % |
| N | < 2 % |
| $CaB_6$ | |
| Ca + B | > 90 % |
| C | < 6 % |
| $ZrB_2$ | |
| Zr + B | > 95 % |
| C | < 1,5 % |

Calcium hexaboride – $CaB_6$

TETRABOR® Boron Carbide – $B_4C$

## Grain size distribution (typical values)

| Particle size - 400 mesh | $B_4C$ | $CaB_6$ | $ZrB_2$ |
|---|---|---|---|
| 3 %-value (min. 97 %) | < 56 µm | < 56 µm | < 56 µm |
| 50 %-value (average) | 3 – 15 µm | 9 – 17 µm | 6 – 17 µm |
| 94 %-value (max. 6 %) | < 1 µm | < 5 µm | < 5 µm |

(Measured with laser diffractometer, Coulter LS 230)

Additional coarser or finer grain sizes on request.

## Properties

| Chemical formula | | | |
|---|---|---|---|
| | $B_4C$ | $CaB_6$ | $ZrB_2$ |
| Crystal structure | | | |
| | rhombohedral | cubic | hexagonal |
| Molecular weight | | | |
| g/mol | 55.26 | 104.95 | 112.845 |
| Specific gravity | | | |
| g/cc | 2.54 | 2.45 | 6.09 |
| Melting point | | | |
| °C | 2,450 | 2,185 | 2,990 |
| °F | 4,440 | 3,965 | 5,415 |
| Hardness (Mohs scale) | | | |
| | 9 | 8-9 | 8 |
| Thermal expansion (20 -1000 °C)*: K-1 | | | |
| | $5 \cdot 10^{-6}$ | $6.5 \cdot 10^{-6}$ | $6.6 \cdot 10^{-6}$ |

*measured on dense shapes

Antioxidants for carbon-bonded refractories / e - 0306



The management system has been certified according to DIN EN ISO 9001, DIN EN ISO 14001. TETRABOR® is a registered trademark of ESK Ceramics GmbH Co. KG.

ESK Ceramics GmbH & Co. KG
Max-Schaidhauf-Straße 25
87437 Kempten, Germany
www.esk.com, info@esk.com

a ceradyne company