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Formation of in-situ Ceramic Phase in N220 Nano Carbon Containing Low Carbon Mgo-C Refractory

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Abstract : In iron and steel industries, MgO–C refractories are widely used in basic oxygen furnaces, electric arc furnaces and steel ladles due to their excellent corrosion resistance, thermal shock resistance, and other excellent hot properties. Conventionally magnesia carbon refractories contain about 8-20 wt% of carbon but the use of carbon is also associate with disadvantages like oxidation, low fracture strength, high heat loss and higher carbon pick up in steel. So, MgO-C refractory having low carbon content without compromising the beneficial properties is the challenge. Nano carbon, having finer particles, can mix and distribute within the entire matrix uniformly and can result in improved mechanical, thermo-mechanical, corrosion and other refractory properties. Previous experiences with the use of nano carbon in low carbon MgO-C refractory have indicated an optimum range of use of nano carbon around 1 wt%. This optimum nano carbon content was used in MgO-C compositions with flaky graphite followed by aluminum and silicon metal powder as an anti-oxidant. These low carbon MgO-C refractory compositions were prepared by conventional manufacturing techniques. At the same time 16 wt. % flaky graphite containing conventional MgO-C refractory was also prepared parallel under similar conditions. The developed products were characterized for various refractory related properties. Nano carbon containing compositions showed better mechanical, thermo-mechanical properties, and oxidation resistance compared to that of conventional composition. Improvement in the properties is associated with the formation of in-situ ceramic phase-like aluminum carbide, silicon carbide, and magnesium aluminum spinel. Higher surface area and higher reactivity of N220 nano carbon black resulted in greater formation in-situ ceramic phases, even at a much lower amount. Nano carbon containing compositions were found to have improved properties in MgO-C refractories compared to that of the conventional ones at much lower total carbon content.

Keywords : N220nano carbon black, refractory properties, conventionally manufacturing techniques, conventional magnesia carbon refractories
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