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Effect of Cr_2O_3 in steel refining slag on the corrosion kinetics of MgO-C refractories

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ABSTRACT

Understanding the high-temperature corrosion of the MgO-C refractories is crucial in terms of extending their lifespan, improving operational and economic efficiencies, enhancing safety while maintaining environmental responsibility. Despite extensive research, the impact of transition metal oxides in ladle furnace (LF) slag on MgO-C refractory corrosion remains insufficiently explored. This study examines the effect of Cr_2O_3 content in a synthetic CaO-Al_2O_3-SiO_2-MgO (CSMA) based slag on the corrosion kinetics of MgO-C refractories, using both experimental and thermodynamic modeling approaches. A synthetic slag was designed to replicate the slag composition at the final stage of LF operation, characterized by high desulfurization and low MgO dissolution capacities. The base slag is MgO-saturated to eliminate the dissolution driving force for MgO. Corrosion experiments were conducted at 1650°C in a horizontal tube furnace under an Ar atmosphere, with varying Cr_2O_3 concentrations of 5 and 10 wt% tested across three distinct time intervals (30, 60, and 90 minutes). Microstructural characterization was conducted using scanning electron microscopy-energy dispersive spectroscopy (SEM-EDS) to evaluate slag penetration depth and corrosion kinetics. The study aims to determine the effective penetration rate coefficient based on established capillary action theories, for varying Cr_2O_3 content and assess how changes in slag properties influence penetration. The findings contribute to a deeper understanding of how slag composition variations affect refractory corrosion in batch production operations, providing insights for optimizing refractory performance and production of higher quality steels.

Keywords: Corrosion kinetics, MgO-C refractories, Ladle furnace steelmaking, Slag engineering