

Materials Science & Engineering Thesis Defense

Study of thermophysical properties of the slag to predict the slag foaming model: Effect of Cr₂O₃ Addition in EAF Slags

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Abstract

The characterization of interface properties in molten slag is crucial for understanding the interface phenomenon and the reactions between slag and metal. This study focuses on examining the influence of Cr₂O₃, an important surface-active oxide, on the wettability and surface tension of slag. Industrial Electric Arc Furnace (EAF) slag with two different Cr₂O₃ contents (1 wt% and 3 wt%) was investigated using the sessile drop measurement technique at a high temperature of 1650°C. For the preparation of 3 wt% Cr₂O₃-doped slags, the following crucibles were used: Al₂O₃, Mo, and MgO. The behavior of crucibles, the dissolution process as well as its effect on the slags' thermophysical properties were studied. For the evaluation of surface tension, Mo and MgO substrates were used. The contact angle was measured using the sessile drop method, and the surface tension was calculated using the Young-Laplace-based software. The interaction and wettability behavior between the slag and different substrates was studied. The effects of Cr₂O₃ content, in correlation with Al₂O₃, Mo, and MgO, as well as temperature, on the contact angle, surface tension, and phase formation were analyzed using FactSage 8.2. The results indicate an increase in the formation of solid phases with Al₂O₃ and Mo dissolution into the slag. The composition of the MoO₃ is confirmed with the XRF and EDS analysis. Furthermore, an increase in the formation of the spinel phase was observed with the addition of chromium, which is confirmed via XRD. The increase in the CaCrMo-oxide-based spinel led to a decrease in the surface tension of the slag. The measured surface tension of the selected molten slag ranged from 672 mN/m, and the surface tension decreased to 404 mN/m with an increase in Cr₂O₃ content. furnace. The effects of the amounts of Cr₂O₃ in correlation with Al₂O₃, MgO, and MoO₃ on the slag foaming index were determined using the existing models in the literature.

Keywords: EAF slag, interface characterization, Cr₂O₃, wettability, surface tension, contact angle, phase formation, FactSage



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Zoom Link: <https://asu.zoom.us/j/83473849141>