Application of thermochemistry in BOF process modeling: What did it teach us about the dynamics of decarburisation reaction?

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Abstract

For an optimal design and control of the BOF (Basic Oxygen Furnace) converter process, a deep understanding of the thermodynamics and kinetics of the refining reactions is essential. The dynamic of the BOF process is complex, as reactions take place between multi-component and multi-phase systems and involve several reaction zones.

In this presentation, an attempt is made to clarify the controversies with respect to the priority of oxidation reactions in the BOF process and why it can be affected by a modification in the blowing conditions. The thermodynamic background of the retardation in the onset of decarburisation reaction observed in the industrial process is discussed. The simulation results of a BOF multi-zone modeling approach, the LD-Sage model, indicate that the retardation in the decarburisation reaction is in some cases not thermodynamically determined, as widely accepted in the literature, but is rather a result of CO-nucleation difficulties. Even though the decarburisation delay promotes early slag formation and early dephosphorization, it increases the risk of excessive foaming and the occurence of slopping once the nucleation barrier is lifted. Thus, if a delay is observed during the operation of the BOF process, it is of outmost importance to recognize whether the delay is thermodynamically or kinetically determined. For this purpose, rigorous thermodynamic modeling approaches, such as the LD-Sage model, can be used. It is further suggested that thermodynamic modeling approaches should include a barrier for CO-nucleation for a successful modeling of the initial stage of oxidation reactions. In case of the LD-Sage model, this was achieved by increasing the CO-partial pressure in the metal-slag-interface reactor.

Key Words

BOF dynamics, decarburisation delay, CO nucleation, LD-Sage, Slopping