

# Use of CaO-Al<sub>2</sub>O<sub>3</sub> Synthetic Slag on EAF Tapping for Steel Desulfurization



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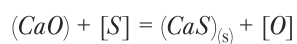
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Steel desulfurization is usually performed by CaO-Al<sub>2</sub>O<sub>3</sub>-based top slags. However, in the steelmaking process at a steel mill in the city of Cariacica, ES, Brazil, deoxidation is carried out on tapping with the addition of ferrosilicon-manganese and silicon carbide, and desulfurization is carried out in the ladle furnace with the addition of lime and calcium carbide. The present work aims to change this process by adding a CaO-Al<sub>2</sub>O<sub>3</sub> system slag during the electric arc furnace (EAF) steel tapping, so that the desulfurization occurs already in this step, thus enabling CaC<sub>2</sub> economy in the ladle furnace. Three lime/alumina briquette ratios were determined, where the CaO activity, liquid slag ratio and viscosity were analyzed. Then, the desulfurization yields of these heats were compared to the conventional route. The influence of additions and of the slag carryover on desulfurization efficiency was analyzed by correlation charts and a mathematical model developed. It was found that the slag carryover from the EAF impairs the desulfurization, causing sulfur reversion from tapping until the ladle furnace arrival, and decreasing the desulfurization rate on the ladle furnace treatment by promoting high-equilibrium sulfur content, close to the real reached value. The most efficient slags were the ones with the greatest calcium oxide activities, which is in line with the steel desulfurization factor.

The research on high-efficiency and low-cost production technology of low-sulfur and ultralow-sulfur steel is an important field since sulfur is known to increase hydrogen-induced cracking, to lower hot ductility, and increase solidification cracking susceptibility during welding processes.<sup>1</sup> The desulfurization (DeS) of liquid steel with basic slags proceeds according to the reaction:<sup>2</sup>



$$\Delta G^{\circ} = 115358 - 38.66T \quad (\text{J/mol})$$

(Eq. 1)

where: ( ) indicates the slag phase and [ ] indicates the

steel phase. It is clear from Eq. 1 that high CaO activity (high basicity) in the slag and a low oxygen potential at the slag/steel interface<sup>3</sup> will drive the desulfurization reaction in the forward direction. However, the desulfurization efficiency cannot be properly modeled with CaO activity in isolation, since the activities of other slag components, such as SiO<sub>2</sub>, FeO and Al<sub>2</sub>O<sub>3</sub>, are all linked to each other. So, activity analysis is important and may be assessed by thermodynamic simulations, considering the simultaneous interaction between all the slag components.

According to some authors such as Turkdogan, Fruehan and Schrama et al.,<sup>4-6</sup> oxygen activity is the most relevant