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Application of hydrochar composite briquettes for sustainable slag foaming process in the electric arc furnace

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An urgent challenge for the iron and steel industry is to reduce its CO2 emissions, which can be achieved through enhancing the energy efficiency and by reducing the consumption of fossil fuels. Slag foaming is an important operation in the electric arc furnace (EAF) process which enhances energy efficiency and promotes more effective refining of the liquid steel. Conventional slag foaming is achieved by simultaneous injection of oxygen into the liquid steel and the injection of fossil coal or coke into the liquid slag. The reduction of iron oxide by carbon generates CO and CO2 which subsequently foams the slag.
One alternative method to realize sustainable slag foaming is by charging self-reducing briquettes into the liquid slag. Such briquette typically contains a metal oxide and a carbon material, which reacts and produces CO gas (and also other gas such as H2, CxHy if the carbon material releases volatiles) at elevated temperatures which promotes slag foaming. By using this method, the amount of oxygen injection required in the EAF process can be reduced by replacing it partially with oxygen present in the metal oxide, which can be a waste or a by-product generated during the steelmaking process (e.g. mill scale, pellet fine). The fossil coal added in the self-reducing briquette can also be replaced by biocarbon for the reduction of fossil CO2 emissions.
This study presents the prospects of utilizing hydrochar (a type of biocarbon)-mill scale composite briquettes to achieving slag foaming in the EAF process. Results from the thermogravimetric analysis of the composite briquettes with different recipes—which reflects the amount of gas formed in the different temperature ranges and the duration of gas formation, would be presented. These results would be used to interpret the findings from laboratory slag foaming experiments, where the composite briquettes were charged into a MgO crucible filled with molten EAF carbon steel slags (~600 g) to determine their slag foaming performance (e.g. total change in slag height, foaming duration). Lastly, the influence of briquette addition on the EAF process, such as energy consumptions, and the compositions of slag and steel would also be discussed.

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