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Potential use of Bio-Coke in Electric Arc Furnace for Steel Production

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The global steel industry is under pressure to reduce carbon emissions. Electric Arc Furnaces (EAF) plays a major role in current steel production with low carbon footprints. Currently, around 30% of global steel production is carried out using EAF. With the growing demand of lower carbon footprint Direct Reduced Iron (DRI) process and increased amount of scrap, demand for EAF steel making is expected to rise. Despite progress toward green steel technologies, carbon remains essential in EAF operations for providing chemical energy, carburization of Steel, slag foaming, and oxygen control. Conventional carbon sources such as metallurgical coke, anthracite, and pulverized coal are fossil-derived and contribute substantially to direct CO_2 emissions. As a result, renewable carbon materials such as biocoke, produced from thermo-chemically treated biomass, are gaining increasing attention as potential substitutes. This paper evaluates the technical feasibility and process implications of using biocoke in the EAF process. The role of conventional carbon sources in EAF steelmaking is first reviewed, that includes (a) charged carbon added with scrap or DRI for providing chemical energy and carburization, (b) injected carbon for slag foaming and FeO reduction, and (c) carbon used as electrodes. Typically, chemical energy supplied through carbon oxidation contributes 15 to 25% of total EAF energy input, while effective slag foaming reduces heat loss and promotes stable arc conditions. The paper also evaluates the performance of biocoke relative to conventional coke based on its carbon content, calorific value, reactivity, ash composition, and mechanical properties. In addition, thermodynamic modelling was conducted using FactSage software to evaluate the interactions of biocoke with molten steel and slag under representative EAF operating conditions. Finally, the study explores the potential of biocoke for slag cleaning applications, focusing on iron recovery from high-FeO containing slags. Together, these insights provide a scientific foundation to support the adoption of biocoke in EAF steelmaking.

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