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Clean iron production by self-reducing agglomerates made in biochar and mill scale: a comparison in reduction efficiency as a function of biochar quality and properties

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Carbon Composite Agglomerates (CCA) or self-reducing agglomerates are based on the compaction of a solid carbonaceous and oxide matrix in the form of pellets, briquettes, etc. with the possible addition of an organic or inorganic binder. As a result, when heated, the carbon acts as a reducing agent and the specific metals contained in the oxide matrix are recovered.
It is therefore not surprising that to date CCAs are gaining increasing interest in the recovery of the iron contained in most metallurgical residues and can therefore be considered as an alternative source of clean iron to direct reduced iron (DRI) or hot briquetted iron (HBI). However, in order to follow a philosophy of full residue recovery and low impact iron production, the use of biogenic carbon sources as reducing agents must be considered in relation to fossil carbon sources.
Consequently, to address the future application feasibility of CCAs, this study focuses on the differences in reduction effectiveness of different biochars obtained from the pyrolysis of wood, agricultural, food residues on one of the main metallurgical residue, mill scale, and the reduction performance comparison when fossil carbon sources are applied as reductants.
The results highlighted the possibility of obtaining either a sponge iron or cast iron as a function of the relative amount of fixed-to-volatile carbon of the reducing agent and the compliance of the reduced CCAs with the benchmark values of commercial DRI. In addition, the chemistry of the gangue was fully comparable to that of electric arc furnaces, consisting mainly of Ca-Al-Si-O compounds, reinforcing the role of self-reducing agglomerates as a parallel clean iron source of the future in metallurgical processes.

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