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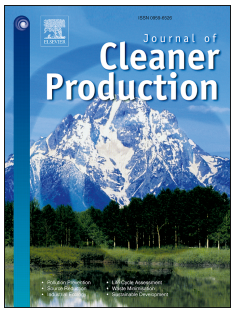

Solar processing of composite iron ore pellets: Preliminary assessments

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1 **Solar Processing of Composite Iron Ore Pellets: Preliminary Assessments**

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Highlights

- A process to utilize solar energy into ironmaking is proposed.
- Mass and energy balance analysis is carried out for solar-smelt process.
- Solar flux requirement and potential reduction in carbon dioxide (CO_2) emission is calculated.
- Solar reduction of composite pellet is demonstrated.
- A preliminary techno-economic evaluation of solar-smelt process is proposed.

Abstract— Composite pellet processes have been used in iron making industry over a number of decades to produce sponge iron from a range of iron ore feed materials. These processes along with all other iron-making units utilize fossil fuel based inputs such as coal, coke and natural gas, for reducing the iron ore feed and fulfilling the energy demand of the process. In this paper, we propose a new iron making process that uses solar energy for smelting the iron ores and limits the coal requirement only to that of required for reduction purposes. Therefore, reducing the overall carbon footprint of the process. Mass and energy balance calculations were carried out for the proposed solar-smelt process and a potential emission reduction of 20 % was obtained when compared to the existing composite pellet processes. The demonstrate the process, preliminary reduction experiments of magnetite ore-lignite coal composite pellets were carried out using a combined solar simulator-reactor setup and 55 % metallization was obtained at temperature of 1130 °C. A preliminary techno-economic and payback period evaluation of the solar-smelt process was carried out based on Australian conditions, which suggests that the feasibility of its commercial application depends on the natural gas price and cost of heliostats. The payback period was estimated to be about 2.5 to 3 years at the present cost of heliostats and natural gas.

Keywords-Composite pellet; Solar-smelt Process; CO_2 emission; Solar Simulator; Payback Period

1. Introduction

Since 1990, the global carbon dioxide (CO_2) emission has grown by 56.4 % to the emission of 35-giga tons carbon dioxide equivalent per year (Gt CO_2–e/year) in 2016 (Global Carbon Atlas, 2016). This alarming carbon footprint has encouraged global energy sectors to adopt renewable power sources such