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# Reduction of $CO_2e$ Emissions in Steelmaking by Material and Process Innovations using Secondary Raw Materials from Recycled Waste Streams

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The steel industry accounts for approximately 10% of global $CO_2$-equivalent ($CO_2e$) emissions, producing around 1.7 tonnes of $CO_2e$ per tonne of crude steel. A transformation towards green steel production by replacing fossil carbon based materials and by using alternatives energy sources such as renewable electricity and hydrogen is essential. However, this transition involves significant technological changes, high capital investment, and an implementation period of about 10 years.

To reduce $CO_2e$ emissions during this transitional phase, it is crucial to optimize specific processing steps and materials within the steelmaking value chain. Targeted technical modifications can deliver substantial emission reductions with relatively short return-on-investment periods. Moreover, the use of recycled or secondary raw materials presents considerable potential for further emissions savings. Replacing primary raw materials with alternatives that are based on recycled materials and have a lower product carbon footprint (PCF) not only decreases $CO_2e$ emissions but also contributes to resource conservation.

This contribution presents the impact of CO2e reduction by using recycled input materials in the electric arc furnace (EAF) steelmaking process. Specific measures include substituting fossil coal with recycled plastic waste, utilizing alternative slag formers and fluxes derived from industrial waste streams, and applying lubricants based on re-refined waste oils. Emission reductions achieved through these approaches are quantified and discussed considering steel production use cases.

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