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Modelling of Hydrogen Flame Interaction with the Scrap Beds in Steelmaking Furnaces

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In steelmaking, burners are essential for delivering heat, particularly in Electric Arc Furnaces (EAFs) and Reheat Furnaces (RFs). Within EAFs, despite the majority of heat being supplied through electric arcs, burners provide heat to cold spots to homogenise heat distribution, enhancing overall thermal efficiency and increasing output. Traditionally, these burners rely on carbon-intensive fuels, which exacerbate greenhouse gas emissions and contribute to environmental issues. Hydrogen has emerged as a cleaner substitute, as its combustion yields no carbon dioxide. However, hydrogen's unique flame characteristics result in different heat patterns and transfer rates within the furnaces. A thorough investigation is needed to grasp these effects and ensure safe adoption in steel production. This research specifically examines the heat transfer dynamics of hydrogen flames versus those from carbon-based fuels, while offering mathematical modelling approaches. Findings indicate that, at equivalent burner output, hydrogen flames deliver superior heating in the initial minutes over propane; yet, achieving this requires a substantially higher hydrogen flow rate, resulting in elevated inlet pressures or velocities. Additionally, the study reveals that hydrogen flames penetrate much deeper into the scrap beds due to their elevated speeds and extended lengths.

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