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Experimental evaluation of a flexible natural gas and hydrogen burner in the electric arc furnace

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In the context of the decarbonization of the steel industry, the electric arc furnace (EAF) has emerged as a primary focus of research. Historically, the EAF has been predominantly utilized in recycling-based steelmaking, specifically for the melting of scrap materials to produce crude steel. The recent surge in research interest in the EAF is driven by the objective of optimizing resource utilization and reducing emissions. Given its primary reliance on electrical energy, the EAF emerges as a promising solution for reducing steel production emissions. In addition to the electrical energy input, the EAF is however equipped with auxiliary burners that avoid 'cold spots'during melting and shorten the process duration by increasing the energy input.

These auxiliary burners typically operate as oxyfuel burners, utilizing a mixture of natural gas and oxygen. The combustion of natural gas represents a potential for reducing CO₂ emissions through the substitution with hydrogen burners. In the RFCS-funded project "DevH2forEAF - Developing and enabling H₂ burner utilization to produce liquid steel in EAF," an innovative injector-burner designed for using oxygen and every mixture of natural gas and H₂ (up to 100% H₂) as the fuel was developed for use in EAF, providing a flexible solution for a possible addition of hydrogen to the natural gas line. This injector-burner was subjected to rigorous testing in a range of trials within the environment of an EAF. A downscaled version of the burner, with a power output of 50 kW, was tested in the pilot-scale EAF of the IOB at RWTH, with a particular focus on analyzing its impact on steel quality. Subsequently, a 3 MW burner was installed in two distinct industrial EAFs and utilized in operation. The results of the pilot tests and the two industrial tests are presented in this paper.

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