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Simulating the use of renewable and alternative Carbon-bearing materials and hydrogen in the Electric Arc Furnace through a flowsheet model

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The European steel sector is challenged by the ambitious objectives of the European Green Deal, which aims to schive climate neutrality by 2050. Therefore, novel C-lean and sustainable steelmaking processes are being investigated through large-scale pilot projects, accompanied by studies on the possibility to improve operating practices and introduce new components in conventional routes. As far as the electric steelmaking route is concerned, replacement of fossil carbon with renewable and/or alternative carbon sources, and use of green hydrogen for heating purposes in electric arc furnaces are being investigated. In particular, within the European project entitled "Gradual Integration of Renewable non-fossil energy sources and modular heating technologies in EAF for progressive CO2 decrease"(GreenHeatEAF –G.A. No. 101092328) a flowsheet model of the Electric Arc Furnace (EAF) process was updated to simulate the addition of biochar/biomass, plastic and tires in the EAF as well as the possibility of feeding the EAF burners with hydrogen or natural gas/hydrogen blends. Such model is being used in scenario analyses aimed at assessing the effects of using such C-bearing materials and/or hydrogen on both process performance and key product characteristics. Preliminary results highlight that no major negative effects on the product are observed from the use of alternative C-bearing material, independently on the way they are introduced in the furnace. However, real industrial trials show that an excessive amount of some of them can compromise operational safety and leads to poor slag foaming. On the other hand, the use of hydrogen in EAF burners leads to a consistent reduction in CO2 emissions, while affecting the moisture content in the off-gases and the hydrogen content in the molten steel.
The paper provides an overview of the model and presents the results of simulations that were carried out in the context of the GreenHeatEAF project.

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