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REDUCING USE OF FOSSIL CARBON AND FUELS TO DECARBONIZE THE ELECTRIC STEELMAKING ROUTE: EVALUATION OF THE EFFECTS OF ALTERNATIVE C-BEARING MATERIALS AND HYDROGEN IN THE ELECTRIC ARC FURNACE

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Electric steelmaking route is considered pivotal for the transition towards C-lean processes: it is expected that the share towards scrap-based electric route will increase in future and that the Electric Arc Furnace will be at the basis of novel routes exploiting direct reduction processes. Scrap-based steelmaking is already well integrated in a circular economy concept, as it exploits a secondary raw material (i.e. scrap) as main feedstock. Nevertheless, the sustainability of this route can be increased and further contributions to lowering its impact can be obtained by replacing fossil carbon and fuels with alternative non fossil materials. Currently, fossil carbon is used for foaming slag formation and for providing part of the chemical energy used in the EAF. Furthermore, also natural gas contributes to provide part of the required heat. However, urgent actions are needed to counteract climate change and to achieve the target of decarbonization expected, for instance, by the Europe in accordance to the European Green Deal. In addition, even more unstable geopolitical situations of main fossil carbon/fuels supplying countries make actions for reducing related dependence fundamental.
In this context, several solutions are under investigations within the project entitled "Gradual integration of Renewable non-fossil Energy sources and modular HEATing technologies in EAF for progressive CO2 decrease (GreenHeatEAF)"(GA: 101092328), that has received funding from the European Union in the Clean Steel Partnership framework of Horizon Europe programme.
Among the different investigations that are being carried out, the use of alternative carbon sources (e.g. biochar) in EAF or the use of hydrogen in EAF burners are considered. Related effects are investigated by using both industrial trials and complementary simulations through a flowsheet model of the entire EAF-based route that has been ad-hoc adapted for the previously mentioned trials. In the present work, after the presentation of the used model, main results of both simulations and industrial trials concerning the exploitation of alternative carbon-sources in EAF will be discussed. The pursued investigations highlight that, although alternative C-materials can generally lead to significant fossil CO2 reduction and did not negatively affect the product or most process aspects, a high ratio of some of them can compromise safety of operations while leading to poor slag foaming. Finally, some first simulation results of hydrogen use in EAF burners will be presented, mainly focusing on the reduction of CO2 emissions, on the increase of moisture content in off-gases and on hydrogen content in molten steel.

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