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Use of alternative carbon bearing materials in electric arc furnace: potential for multiple industrial symbiosis and process integration solutions

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In order to improve the sustainability of scrap-based steelmaking and making this route less dependent on fossil carbon markets, the replacement of anthracite and fossil foaming carbon with alternative carbon bearing materials is a promising solution. Different materials can be considered for this purpose, such as biomass, biochar, plastics and tires. All these materials are generally by-products or wastes of other sectors. Therefore, their use represents an implementation of the industrial symbiosis concept and allows electric steelmaking to further increase its contribution to the implementation of circular economy in the steel sector. However, the feasibility of the usage of these alternative carbon bearing materials depends on their availability and on their features and effects on the process. Therefore, analyses, simulation with dedicated EAF flowsheet model, and industrial trials have been performed during the Horizon Europe 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)". Availability of alternative carbon sources has been explored, simulations on the effects on process and products have been performed and industrial trials have been carried out to explore foaming effects and safety aspects. Generally, together with significant reduction of fossil CO2 emissions, no significant negative effects have been observed with the simulated alternative carbon-bearing materials. However, industrial trials carried out without changes of standard injection systems showed limits for some of them in terms of safety and slag foaming.
Further simulations have been also carried out in process integration contexts to extend the availability of suitable alternative carbon sources. In particular, biomass upgrading is explored by investigating the possibility of recovering part of the electric steelworks available waste heat for this kind of processes. To this aim, EAF flowsheet model has been coupled with two flowsheet models related to biomass pyrolysis and torrefaction.
The contribution focuses on the main results of the listed investigations and provides main barriers and facilitators that can pave the way to these multiple industrial symbiosis solutions.

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