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Efficiency of bio-carbon as slag reduction and slag foaming agent in EAF

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As the transition towards green steel production is progressing, the direct use of carbon in the EAF for slag foaming and slag reduction has an increasing portion of the remaining CO2 emissions for steel production. In many cases the total carbon consumption in the EAF is increasing with the increasing percentage of DRI and HBI in the charge material mix. It is therefore important to minimize the use of fossil carbon as input material to the EAF. The use of bio-carbon for this purpose is investigated in the EU-funded Horizon Europe project GreenHeatEAF.

To investigate the efficiency of bio-carbon in relation to anthracite in terms of carbon yield to reduction of metal oxides in slag as well as the comparative effect on slag foaming, pilot trials in the Swerim 10 ton EAF was carried out within the GreenHeatEAF project. The trials consisted of 25 heats with varying charge materials (scrap, DRI and HBI) and different charging strategies (bucket charging and continuous feeding). Anthracite and highly pyrolyzed bio-carbon (89 % C and <5 % volatile matter) was used as injection-carbon with the target to achieve the same FeO-content in the slag.

Slag and steel samples were taken on 3-5 occasions during each heat at different stages of the process to evaluate the carbon yield during different conditions. Together with material composition data, temperature measurements and logged process data, a stagewise mass- and heat balance model developed in HSC was used to evaluate the carbon yield.

The evaluation of the trials showed that the anthracite for slag-foaming and slag reduction can be fully replaced with bio-carbon, although the yield of C in the investigated bio-carbon to reduction of metal oxides in the slag was about 20-25 % lower than for C in anthracite.

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