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Innovative Approaches To Sustainable FeCr Production Through Biocarbon and H2 Utilization

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Ferrochromium (FeCr) alloy is essential in the production of stainless steel and specialty steels. The urgency for sustainable production methods is increasing due to the rising carbon footprint. One promising solution is incorporating biocarbon as a partial substitute for coke in submerged arc furnaces (SAF), while also maximizing the recycling of iron-bearing materials, such as mill scale from the special steel industry. Additionally, utilizing H2 as a reducing agent for iron oxides can significantly lower carbon consumption and mitigate fossil CO2 emissions. Exploring the potential for the partial reduction of chromite ores further enhances these sustainability efforts.

In this study, biocarbon-chromite briquettes were developed on a technical scale using vibro-press and roller press techniques to optimize carbon content. Various binders and additives were employed to achieve optimal results. It was possible to reach 10% biocarbon in vibro-pressed briquettes and 20% in roller-pressed briquettes without compromising the briquette‘s quality. The briquettes underwent mechanical strength evaluation and were subsequently processed for reduction using H2. The reduction process was analyzed through thermogravimetric analysis coupled with quadrupole mass spectrometry (TGA-QMS) at temperatures up to 1100℃. Results indicated that H2 effectively reduces mill scale, primarily composed of FeO, within the temperature range of 600℃ to 750℃, while biocarbon enhances the partial reduction of chromite ore (FeCr2O4) at higher temperatures.

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Primary authors: MOUSA, Elsayed (Swerim AB); Mr MANU, Karthik (Swerim); Mr ÅNNHAGEN, Ludvig (Vargön Alloys AB); Mr TIRAANI, Nizar (Vargön Alloys AB)

Presenter: MOUSA, Elsayed (Swerim AB)

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