HIsarna Process Simulation Model: Using FactSage with Macro Facility

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The HIsarna process is one of the emerging technologies for reducing the carbon footprint of the ironmaking process, which is currently in the pilot plant stage. A kinetic HIsarna process simulation model based on the effective equilibrium reaction zone concept has been developed using the FactSage macro programming facility to advance understanding of the whole process. In the model, the HIsarna process is conceptually divided into various equilibrium zones involving combustion, coal pyrolysis and gasification, gas/slag/carbon reactions, and slag/metal reaction. The model has been validated through the pilot plant data, and the results are in good agreement with the quantity and composition of hot metal, slag, and gas. The HIsarna off-gas stream with high CO_2 content can potentially allow capture and storage directly for carbon mitigation. The utilization of titanium magnetite ore in the HIsarna process has also been investigated via the developed model. The injection of titanium magnetite ore which has high FeO content decreases coal consumption. Still, it increases the slag volume as higher gangue content when keeping the same productivity as the pilot plant trial. The HIsarna process shows promising potential in using low-quality high titania iron ore as feed materials, but the slag system needs to be further optimized. From the heat distribution, the off-gas sensible heat accounts for a large part of the input heat due to its high temperature but can be recovered with good efficiency. The present model is an efficient tool for understanding the HIsarna process and providing theoretical guidance for future pilot research.