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Determining of iron oxide pellet porosity using image analysis

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Hydrogen-based reduction of iron oxide is a promising new technology in fossil-free steelmaking. In the process, the iron oxide is usually fed in a form of spherical pellets or briquettes. In solid-gas -reactions, the porosity of the pellets is assumed to enhance the reduction kinetics via the increase of the available reaction surface area at the reaction interface. However, the multivariable and complex dynamics of the reduction system complicates the estimation of this effect, as it is known that the properties of the pellet evolve withing the progression of the reduction.
In the kinetic analysis procedure, determining the pellet porosity is a demanding task. Measuring the porosity of the pellets is conventionally based on tomography analyses. However, image analysis of SEM-images of pellet cross-section could provide more practical approach. In this study, a sophisticated image analysis procedure is developed to analyze the pellet porosity based on cross-section images. It was found that the porosity based on image analysis correlates reasonably well with the tomography analysis. In addition, the effect of cross-sectional porosity on the reduction rate of the pellets is analyzed by making use of numerical and statistical analysis.

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