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New insights into the relationships between sinter mineralogy and physical strength using QXRD and optical image analysis

The relative influences of sinter mineralogy, sintering temperature, solid and pore macro- and microstructure on iron ore sinter physical strength are not yet fully understood. Whilst a range of analysis techniques have been used by researchers to evaluate sinter physical properties and sinter mineralogy, none have been able to directly link sinter mineralogy and physical strength under controlled conditions. CSIRO has developed a unique laboratory method to study the fundamental melting properties of fine iron ores in a laboratory furnace under a controlled temperature and gas atmosphere environment designed to simulate the industrial sintering process. Compacted tablets samples for a 0.41% and a 2.5% Al2O3 series were fired in a tube furnace at various temperatures, cooled, then tumbled using a modified Bond abrasion test apparatus to determine a relative tumble index (TI) at each temperature. Quantitative XRD (QXRD) analysis was then carried out on the tumbled samples and optical image analysis (OIA) was conducted on polished sections of a separately fired compact in each case. The amount of total SFCA was found to decrease with increasing firing temperature for both alumina series with the total amount of SFCA higher in the 2.5% Al2O3 series compared to 0.41% Al2O3 series samples. The increase in the amount of magnetite and hematite with increasing firing temperature was largely at the expense of a decrease in total SFCA. Overall, there was good agreement between the quantitative mineralogy determined from QXRD versus OIA for SFCA and magnetite but not hematite. Qualitative analysis of high magnification images of the sinter correlated with both the OIA and QXRD results

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