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Analysis of iron sinter by X-ray diffraction reduces CO_2 emissions

Aeris
Metals edition

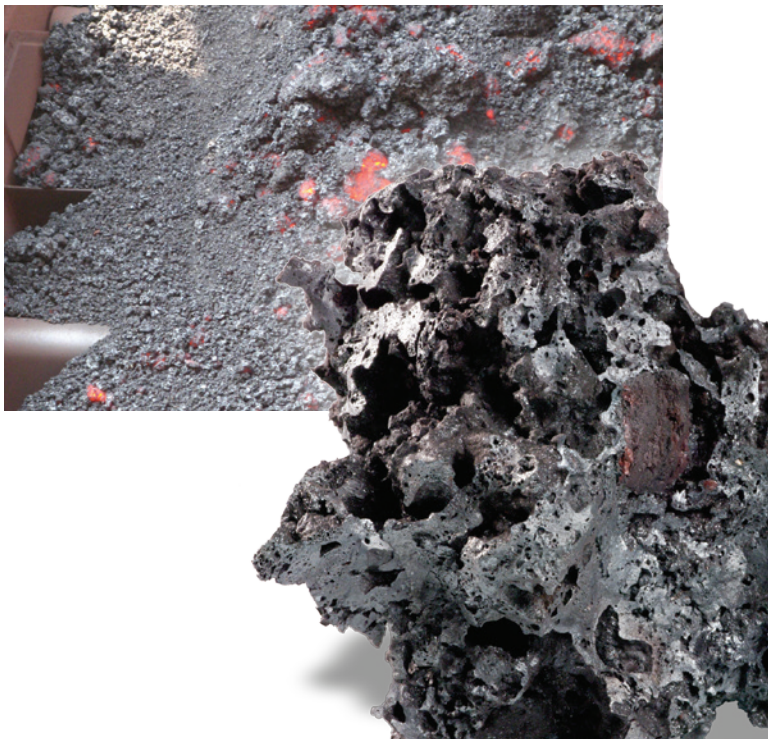
Summary

The Metals edition of the Aeris benchtop X-ray diffractometer is shown to be an easy tool for fast and cost-effective analysis of FeO, basicity and other process-relevant parameters in the production of iron sinter. Additionally, mineralogical phase composition of the raw mixture is provided. The results show very good agreement with independently determined reference values and a high repeatability.

Introduction
Iron sinter is an important feedstock material for the steel industry. Due to increased quality requirements and the need to reduce energy consumption and CO_2 emissions, the phase composition and chemistry of iron sinter need to be analyzed fast and precisely. The fuel consumption per ton iron ore sinter is approximately 60 kg coke. A small fuel saving due to improved process control already represents a significant saving in energy and costs.

X-ray diffraction (XRD) is a fast and cost-effective method for the analysis of process-relevant parameters during the production of iron sinter. The Metals edition of Aeris is the first benchtop X-ray diffractometer that is designed for process control in the iron and steel production. In this data sheet we show typical results of the analysis of Fe^{2+} (FeO), basicity and phase composition.

Experimental
In order to show the capabilities of the Metals edition of Aeris, several samples from different stages of the iron sinter production were analyzed. The presented data were measured using cobalt radiation, which is especially suited for materials with high iron contents, as it produces high-resolution data. The measurement time was 5 minutes per sample, followed by data processing and evaluation.



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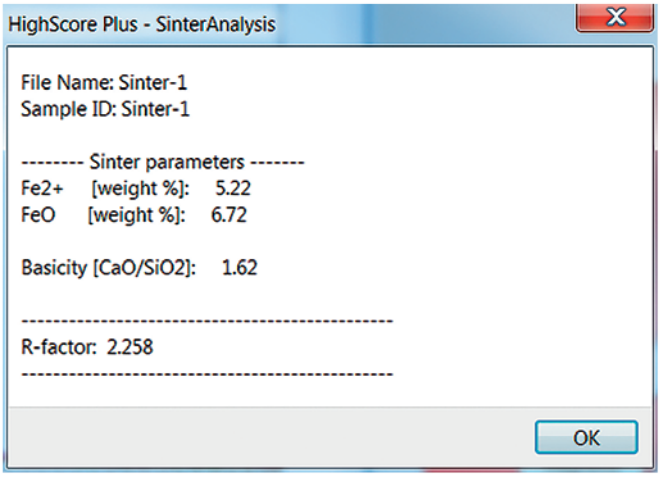
Result and discussion

A total of 48 individual sinter samples with $Fe^{2+}O$ values ranging from 5 to 9.3 wt.% and a basicity (CaO/SiO_2) between 1.5 and 1.7 were analyzed by Aeris using XRD in combination with a fully automated Rietveld refinement and partial least squares regression (PLSR). In addition to the phase composition including the amorphous fraction, the FeO content as well as the basicity were obtained from the same 5 minute scan of each sample (Figure 1).

The comparison of the provided values with independently determined reference values of FeO (wet chemistry) and basicity (X-ray fluorescence) shows very good agreement. Even small variations in the process parameters can be identified allowing a very effective screening of the sintering process (Figure 2a).

The repeatability of the analysis was tested by performing 50 individual measurements of a sinter sample and repeatedly running the automated analysis. The result shows that the analysis is stable and reliable with estimated standard deviations (3σ) of 0.168 wt.% and 0.009 for FeO and the basicity, respectively (Figure 2b).



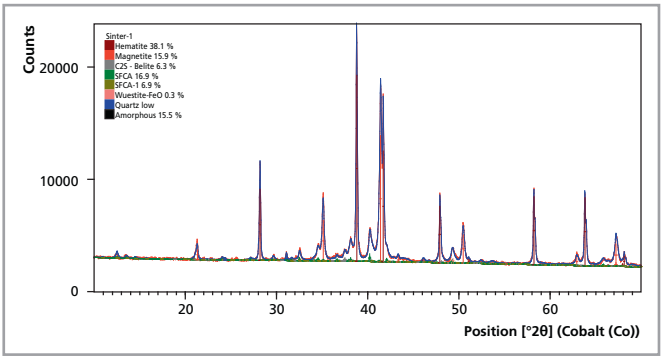


Figure 1. XRD refinement showing full phase characterization of a Fe-sinter measurement scan

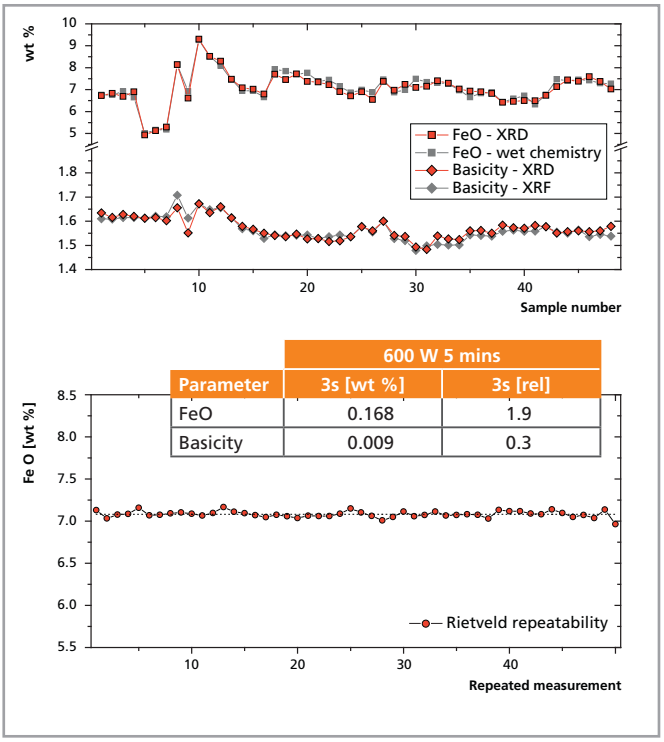


Figure 2. (a) Comparison of FeO and basicity obtained by XRD with independent reference values. (b) Repeatability of the automated XRD analysis procedure

Conclusions

The presented results show that the Metals edition of the Aeris benchtop X-ray diffractometer is a fast and reliable tool to determine FeO, basicity and other process-relevant parameters for the production of iron sinter. Accurate determination of phase composition (including the amorphous fraction) and process parameters contribute to an improvement of the process, with the ultimate benefit of reducing energy consumption and CO_2 emissions.

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