QUANTITATIVE PHASE ANALYSIS OF LATERITIC BAUXITE WITH NIR-SPECTROSCOPY

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The project investigates the applicability of near-infrared spectroscopy for bauxite mining sites, namely the possibility to use this analysis method directly at conveyor belts to guarantee a continuous quantification of bauxite material. The idea is to use modal quantification from XRPD/Rietveld refinement and/or XRF analytics as reference and combine the results with NIR-spectra in a multivariate calibration model.

The material used in this investigation originates from Paragominas, Brazil and consists of the minerals Gibbsite $[Al(OH)_3]$, Kaolinite $[Al_2Si_2O_5(OH)_4]$, Goethite $[FeO(OH)]$, Hematite $[Fe_2O_3]$ and Anatase $[TiO_2]$. To reduce preferred-orientation in XRPD-measurements, samples were ground, sieved and prepared with ethanol on a glass slide. Samples for XRF analytics were prepared with Li-tetraborate fusion technique for major element analysis.

The result of the calibration shows that, for the industrial application of NIR-analytics two crucial points must be considered: (1) it is necessary to crush the bauxite material in order to get unbiased measurements, since bauxite is inhomogeneous with respect to size and modal composition; (2) humidity has a great influence on NIR-spectra in changing band-intensities, which leads to an underestimation of crystalline phase concentrations and needs to be corrected.

In this study, a calibration model is presented using partial-least-squares regression (developed by ABB), dividing samples randomly into a training and test set. The training set generates the model, which is used to predict modal compositions of the test set (Fig. 1). The results show a predictability of the major mineralogical phases within ± 5wt% (2σ). Our results enable a useful application of NIR-spectroscopy at appropriate mining sites.
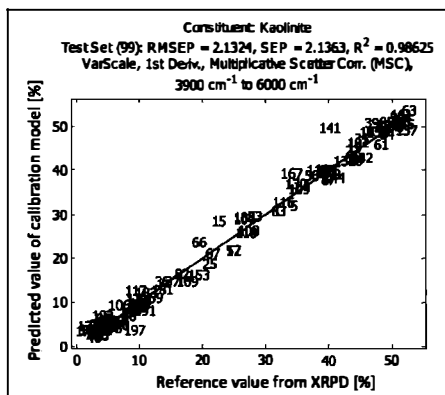

Figure 1

Example of a calibration result for kaolinite in lateritic bauxites: On the x-axis Kaolinite concentrations determined by XRPD/Rietveld (reference values) are shown. The y-axis plots the predicted kaolinite concentrations of a calibration model based on NIR-spectra. Note that RMSEP defines the 1σ-error of reference values vs. NIR-based predictions.