X-RAY DIFFRACTION IN IRON AND STEEL INDUSTRIES – GRADE CONTROL, PROCESS OPTIMIZATION AND MINIMIZING ENERGY CONSUMPTION AND CO2 EMISSIONS

Authors:
Uwe König[1], Jennifer Anderson[2], Luciano Gobbo[3] & Katherine Macchiarola[2]

[1]PANalytical B.V., Almelo, Netherlands
[2]PANalytical, Westborough, MA, USA
[3]PANalytical, São Paulo, Brasil

X-ray diffraction (XRD) has evolved from a research tool capable of providing useful information in terms of quantification of the crystalline phases and the amorphous content to a fully mature technique for quality and process control in mining, steel, cement and aluminum industries. Knowledge of the mineralogical phases present in an ore body allows operators to optimize mining and process operations (flotation, separation, etc.). Furthermore, XRD can be used as an efficient tool for identifying the means to reduce CO2 emissions through knowledge of phase composition of starter materials and the subsequent selection of those materials that process more efficiently into finished products.
Cluster analysis of XRD data facilitates multi-dimensional compositional mapping of ore deposits and drill cores, identifying regions of favorable mineral compositions. Automatically sorting closely related diffraction data into separate clusters and identifying the most representative scan of each cluster as well as outlying patterns. The paper describes several case studies where XRD and data clustering are used for grade control of iron ores, analysis of the iron ore sinters, determination of process relevant variables like the metallization in Direct Reduced Iron (DRI) and the phase analysis of ferrochrome slags. Details of the techniques used, sample optimization methodologies, results, data precision and limitations will be presented and discussed. The analytical approach presented here has enormous potential as an inexpensive, reliable tool, useful in the characterization of materials and the minimization of CO_2 emissions and energy consumption.