

ONLINE AND REAL-TIME QUANTIFICATION OF CEMENT CLINKERS USING XRD

Kern, A. & Schmidt, R.

Bruker AXS GmbH, Karlsruhe, Germany

Knowledge about the absolute phase abundance in cement clinkers is a requirement for both, research and quality control. Traditionally, quantitative analysis of cement clinkers has been carried out by theoretical normative calculation from chemical analysis using the so-called Bogue method or by optical microscopy.

Therefore chemical analysis, mostly performed by X-ray fluorescence (XRF), forms the basis of cement plant control by providing information for proportioning raw materials, adjusting kiln and burning conditions, as well as cement mill feed proportioning. In addition XRF is of highest importance with respect to the environmentally relevant control of waste recovery raw materials and alternative fuels, as well as filters, plants and sewage.

However, the performance of clinkers and cements is governed by the mineralogy and not the elemental composition and the deficiencies and inherent errors of Bogue as well as microscopic point counting are well known.

With XRD and Rietveld analysis a full quantitative analysis of cement clinkers can be performed providing detailed mineralogical information about the product. Until recently several disadvantages prevented the frequent application of the Rietveld method in the cement industry. As the measurement of a full powder pattern is required, extended measurement times made an integration of this method into existing automation environments difficult. In addition, several drawbacks of existing Rietveld software such as complexity, low performance, and severe instability were prohibitive for automated use.

The latest developments of on-line XRD instrumentation, as well as dedicated Rietveld software for quantitative phase analysis (TOPAS), now make a decisive breakthrough possible. TOPAS not only allows the analysis of extremely complex phase mixtures in the shortest time possible, but also a fully automated on-line phase analysis for production control and quality management, without any user input. In addition, using the latest PSD (position sensitive detector) detector technology in a new process diffractometer, measurement and evaluation times can be brought down to minutes, enabling real time control of the cement clinker mineralogy.