APPLICATION NOTE

Quantitative phase analysis of mining products for ceramic industry with ARL EQUINOX 100 X-ray Diffractometer

Introduction

Most of the resources used by mankind are gathered by mining. Ceramics are one of the most important and commonly used materials in modern society. Therefore the demand on natural resources for ceramic production is high. The majority of commonly used ceramics are produced from clay minerals like Kaolin, while for high temperature application ceramics made from Magnesite are widely used. Such ceramics are the key material used for furnaces in cement production. To optimize the production process and to reduce the energy consumption Feldspar materials are used as a flux for the melting process of raw materials. The composition of the starting mixtures are important to control the quality of the product. Therefore it is crucial to determine the mineral composition of the resources used in production. For this purpose X-ray diffraction is one commonly used technique to determine the composition of minerals in mining and processing industries.

Instrument

Thermo Scientific™ ARL™ EQUINOX 100 employs a custom-designed Cu (50 W) or Co (15 W) micro-focus tube with mirror optics. The low power consumed by the unit allows it to be completely tranportable, not requiring an external water chiller. The same unit is capable of being transported between laboratories without the need for special infrastructure.

The ARL EQUINOX 100 provides very fast data collection times compared to other diffractometers due to its unique curved position sensitive detector (CPS) that measures all diffraction peaks simultaneously and in real time and is therefore well suited for both reflection and transmission measurements (Figure 1).

Experimental

Ball clay, kaolin, magnetite and feldspar samples (3 min, 20 Hz) were measured in reflection mode. The samples were analyzed using Cu Kα (1.541874 Å) radiation for 10 minutes with the sample rotated during the analysis. MATCH! combined with ICDD pdf4+ database was used for qualitative phase analysis, while MAUD was used for Rietveld quantification.

Figure 1: ARL EQUINOX 100 X-ray diffraction system

Results

The phase composition of the samples was determined by consecutive Rietveld refinements. A sample of ball clay contains 15% quartz and 85% kaolinite, which is quite untypical for ball clay (Figure 2). A mineral with similar composition is kaolin which in this case contains 7% quartz and 93% kaolinite (Figure 3).

Figure 2: Rietveld fit of a ball clay sample (5°-100° 2θ).

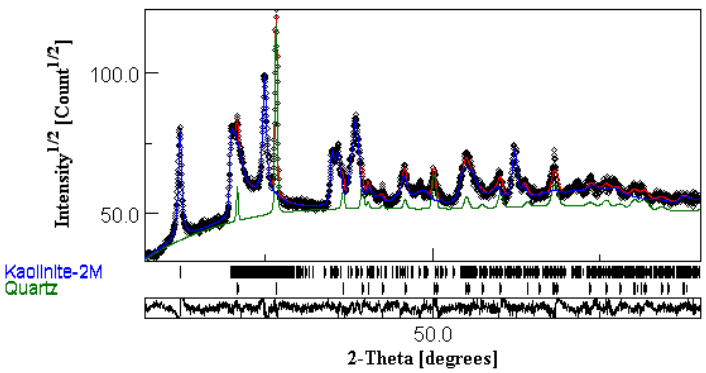

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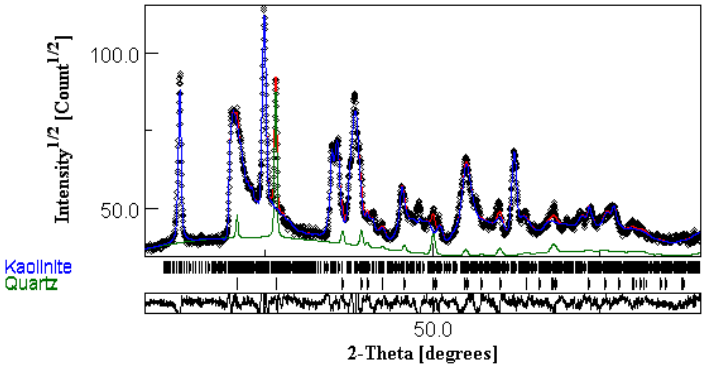
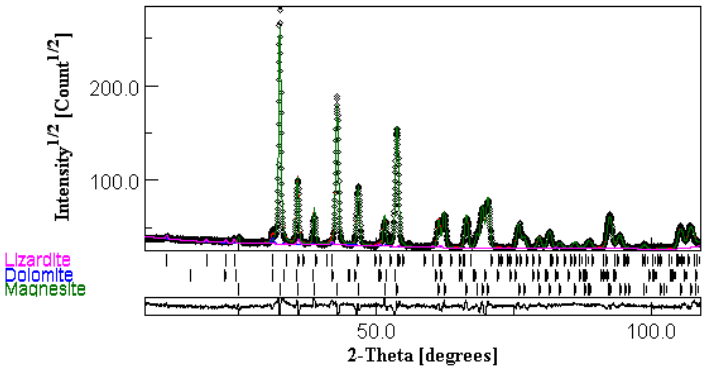
Figure 3: Rietveld fit of a kaolin sample (5° -100° 2θ)



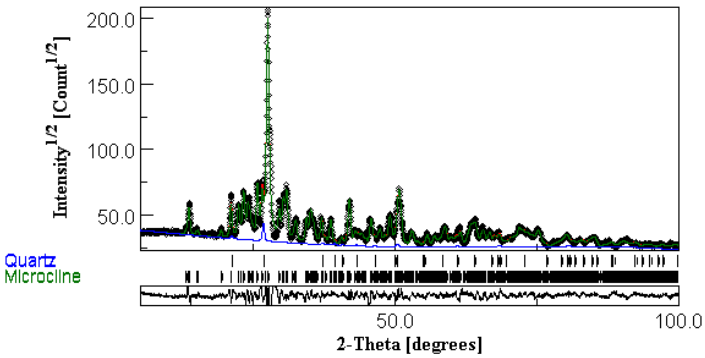
Magnesite (98%) in this case is only accompanied by traces of dolomite (1%) and lizardite (1%), which emphasizes the quality of this material (Figure 4).

Figure 4: Rietveld fit of a magnesite sample (5° -110° 2θ)



Many different types of feldspar materials are known. In this case the sample predominantly consists of microcline (98%) with some trace of quartz (2%) (Figure 5).

Figure 5: Rietveld fit of a feldspar sample (5° -100° 2θ)



Conclusion

The ARL EQUINOX 100 is a suitable instrument to determine the phase composition in mineral samples connected to the production of ceramic materials. MATCH! and MAUD cover all needs for the determination of the phase content as well as the quantification of these phases. Therefore the ARL EQUINOX 100 is a convenient and cost effective XRD solution for QA/QC procedures in the ceramic industry and is also appropriate for the use at mining sites due to its ease of use and robustness.

Find out more at **www.thermofisher.com/xrd**

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