

# Quantitative phase analysis of a phosphate rock sample for fertilizer production using ARL EQUINOX 100 X-ray diffractometer

## Introduction

Fertilizers usually consist of Nitrates and Phosphates. In general the phosphorous originates from Phosphate rock. There is a large variety of minerals which influence the content and availability of phosphorous in phosphate rocks. One standard technique to distinguish between the different mineral phases in the raw material is X-ray diffraction (XRD). With this method it is possible to quantify the content of different minerals according to their crystallographic structure.

## Instrument

The Thermo Scientific™ ARL™ EQUINOX 100 employs a custom-designed Cu (50 W) or Co (15 W) micro-focus tube with mirror optics. The low wattage consumed by the unit allows it to be completely portable, 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).

Figure 1: ARL EQUINOX 100 X-ray diffractometer



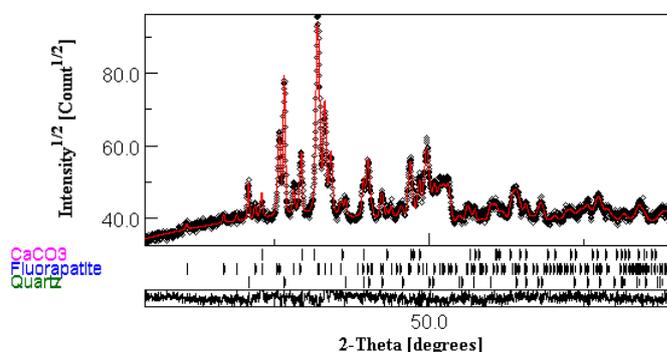
## Experimental

A ball milled Phosphate Rock sample (3 min, 20 Hz) was measured in reflection mode. The samples were analyzed under Cu K $\alpha$  (1.541874 Å) radiation for 10 minutes with the sample rotating during the analysis. MATCH! combined with COD database was used for qualitative phase analysis, while MAUD was used for quantification.

## Results

A Rietveld refinement yielded the phase composition of the sample. It contains 4% of Calcite, 17% of Quartz and 79% of Fluorapatite (Figure 2) which corresponds to a quite high phosphorous content (P<sub>2</sub>O<sub>5</sub> ~ 26 %).

Figure 2: Rietveld fit of a phosphate rock sample



## Conclusion

The ARL EQUINOX 100 is a suitable instrument to evaluate the quality of phosphate rocks using Rietveld's method both in the field and in production plants due to its ease and robustness. MATCH! and MAUD cover all needs for quantification of phosphate related minerals.