

X-RAY DIFFRACTION

D6 PHASER 600W

Cement Phase Quantification

Application Report 47

The D6 PHASER is a multipurpose benchtop diffractometer that is uniquely suited for modern quality and process control in many industries. In this report, we present the capabilities of this system in state-of-the-art cement characterization.

Sample Preparation

The sample has been prepared in a steel ring with 51.5mm outer diameter using a combined mill and press. A grinding aid has been chosen so as not to contribute significantly to the XRD signal. The milling conditions have been defined to retain soft phases like the sulphates Gypsum, Hemi-Hydrate and Anhydrite.

Measurement Strategy and Data Quality

The combination of the energy dispersive LYNXEYE XE-T detector and the motorized air scatter screen (MASS) results in data with outstanding low and flat background. Thanks to the superb energy resolution of the detector not only K-beta is removed, without the need for a filter, but also iron fluorescence and white beam residues are eliminated. The motorized air scatter screen removes air scattering in the low angle range, which results in a linear background. Consequently, this methodology leads to a notable improvement in the detection limits for minor and amorphous phases. Additionally, it enables the accurate quantification of phases associated with pre-hydration, such as Syngenite and Ettringite, which exhibit their primary peaks within the lower angle range.



Figure 1
D6 PHASER using a tube
load of 600W.



Figure 2
Rotation Sample Stage with motorized Primary Optics and motorized Air Scatter Screen.

Results

The 600W version of the D6 PHASER allows high quality data to be collected for cement phase quantification in 10 minutes. The combination of high overall intensity, superior resolution and minimal background yields phase quantification accuracy and repeatability values comparable to those achieved by floor-standing systems.

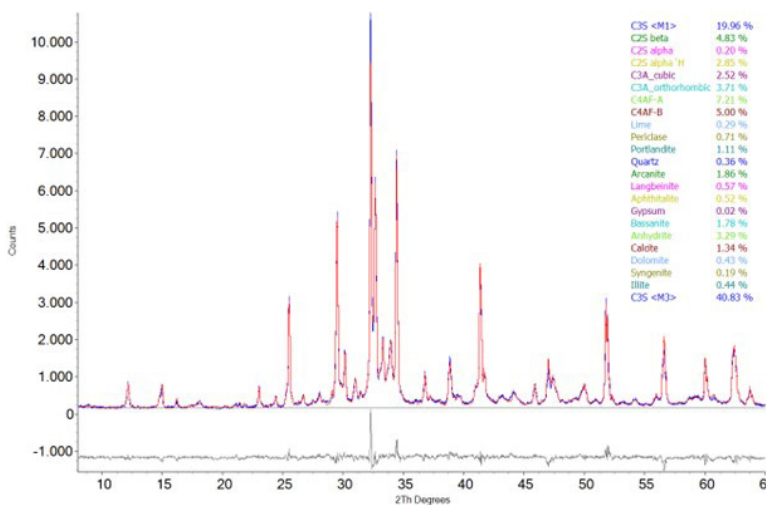
Data evaluation is performed using the worlds leading Rietveld software DIFFRAC.TOPAS which employs the Fundamental Parameters Approach.

The list of considered phases for cement analysis includes pre-hydration tracers like Syngenite. In addition to determining phase composition, the calculated results also encompass various parameters for automated verification of sample preparation quality. The Results Manager facilitates statistical analysis and limits checks.

Through our proprietary communication interface AXSCOM the system can seamlessly integrate with laboratory automation and transfer results to the plant's LIMS system.

Summary

The D6 PHASER benchtop system achieves performance and data quality on par with floor-standing systems, making it an invaluable asset for enhancing process control and ensuring quality in cement and grinding plants.



The Cement data were collected with a D6 PHASER 600W, Cu radiation, no filter, 4° primary side axial Soller collimator, primary variable divergence (constant aperture, 0.5°), motorized air scatter screen, 4° secondary side axial Soller collimator. The measurement was performed as a continuous 1D scan from 8 to 65° 2Theta, 0.02° step width, exposure time of 0.2sec per step, with a 4.5° opening of the LYNXEYE XE-T detector. The measurement duration was 10 minutes 9 seconds.

Figure 3
CEM I Rietveld plot: data collected on the D6 PHASER 600W and evaluated by DIFFRAC.TOPAS v7.

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