



Rotary Kiln



D4 ENDEAVOR



LYNXEYE
Detector

Application Report XRD 15

DIFFRAC.DQUANT: Control of free lime content in clinker

In the cement plant the control of free lime is the most basic but sound base for enormous cost savings during kiln operation. The classic calibration method implemented in DIFFRAC.DQUANT provides accurate and precise quantitative phase analysis.

Quantitative phase analysis by X-ray powder diffraction is used for the determination of clinker mineralogy in cement production. The free lime content is a direct indicator of the kiln performance. Decreasing the kiln temperature while burning at softer conditions directly decreases fuel consumption. Furthermore, it extends the refractory's lifetime in the kiln, thus decreasing maintenance costs and down-times. Lower burning temperatures reduce emissions contributing to a cleaner environment.

Here, we present the quantification of free lime in clinker by the calibration method, which

- can be easily automated. Operator efforts are reduced to the push of a button. Results are directly transferred to plant control.
- is very fast as only one range needs to be measured. A detector fixed-scan with about 4° detector opening takes 60 sec only
- is precise and accurate since it is based on a set of calibration standards.
- may reveal long term trends because of high stability due to

a robust drift correction.

- is insensitive to preferred orientation of other components in the mixture,
- and delivers the absolute concentration even in the presence of unspecified (e.g. amorphous) material.

Figure 1 shows the lime peak of 19 standard samples that cover the concentration range from 0.15 to 2.7 wt-%. XRD data were collected using a D4 ENDEAVOR diffractometer, equipped with a Cu tube and a LYNXEYE linear silicon strip detector.

The resulting calibration curve is shown in Figure 2. It clearly shows a linear correlation (Pearson correlation coefficient = 0.989) between the standard concentrations and the related integrated intensities of the lime peak. The root mean sum of absolute deviations of standard concentrations (RMSC = 0.084) is below 0.1 wt-%. This represents a very small bias between the calculated and standard concentrations. The standard deviation of the calibration is very small (SDEC = 0.032 wt-%). It is an expression of the very small scatter of the concentration bias. It also indicates high homogeneity of the set of standards as well as the very high stability of the intensity measurement of the diffractometer.

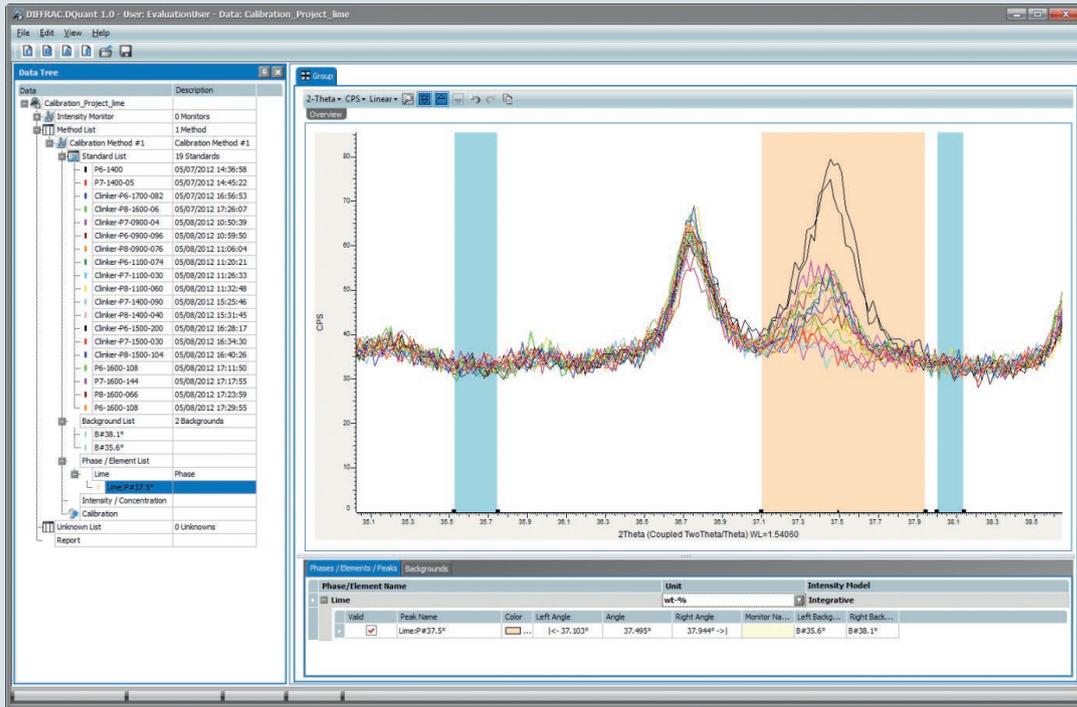


Figure 1: Free lime peak of the calibration standards in DIFFRAC.DQUANT. The orange color represents the range of interest for the intensity integration, while the blue ranges indicate the ranges used for linear double sided background subtraction.

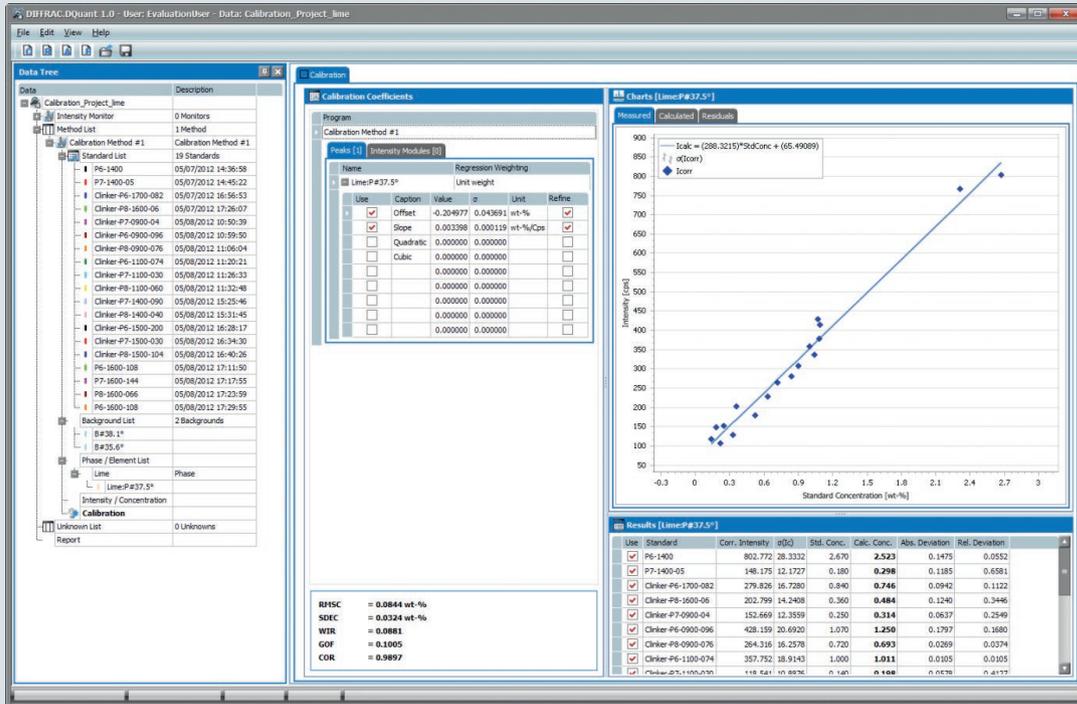


Figure 2: Calibration view of DIFFRAC.DQUANT for the straight line calibration method.


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