

Investigating cement clinker composition differences with XRD and XRF

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The chemical composition and relative abundance of crystalline phases in a cement clinker are known to impact cement properties. Analytical approaches to characterize cements are widely published and include several ASTM methods. From elemental analysis an estimate of crystalline phase abundance can be obtained through Bogue calculation (ASTM C150). However, direct crystalline phase identification (C3S, C2S, C3A, C4AF, and others) and quantification is better conducted by powder diffraction analysis (ASTM C1365). For crystalline phase quantification Rietveld refinement is preferred and expected to lead to higher accuracy compared to single peak integration. Elemental composition can also be estimated from XRD quantification with the understanding that trace phases are difficult, if not impossible to evaluate, when amorphous. The comparison between the two sets of results (XRF, XRD) increases the level of confidence in the analysis.

In this paper we illustrate the analysis of several cements some of which were known to have performance differences, and illustrate results obtained through XRF and XRD analyses. We evaluated the impact of sample preparation, in particular grinding, and of different optics conditions on the diffractometer to optimize count rates vs. low angle air scattering.