Quantitative Phase Analysis of Natural Pozzolans via Rietveld Refinement: Determining Crystalline and Amorphous Content for the Application as SCM

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The global standard of cement industry, Portland cement, is constitute by a mixture of clinker and other materials. Clinker is produced by firing a mixture of limestone and clays, with the former that decomposes following the reaction $CaCO_3 \rightarrow CaO + CO_2$. This step alone accounts for about 50% of total CO_2 emission in cement industry, with about 0.87 kg of CO_2 emitted every kilogram of Portland cement produced [1].

A primary strategy to mitigate this issue is the partial replacement of clinker with other materials, called SCMs (Supplementary Cementitious Materials). Among these, Natural Pozzolans (NPs) are particularly promising due to their abundance, low cost and minimal processing requirements. These materials, typically consisting of low-Ca silicates or aluminosilicates, react during cement hydration phase and increase the mechanical performance and the durability of cement itself [1, 2].

In this study, we provided an in depth characterization of five different NPs by X-ray powder diffraction technique. After preliminary qualitative phase analysis, the Rietveld method was applied for Quantitative Phase Analysis, in order to quantify the phase assemblage as well as the amorphous content, this latter one possibly very important for the reactivity of NPs [2].

XRPD data were collected in Bragg-Brentano geometry utilizing Cu-Kα radiation over a 2ϑ range of 3-70°. Rietveld refinement was performed using the GSAS-II software [3]. The amorphous content was subsequently calculated by rescaling the crystalline phase weight fraction based on the known concentration of the corundum used as internal standard [4].

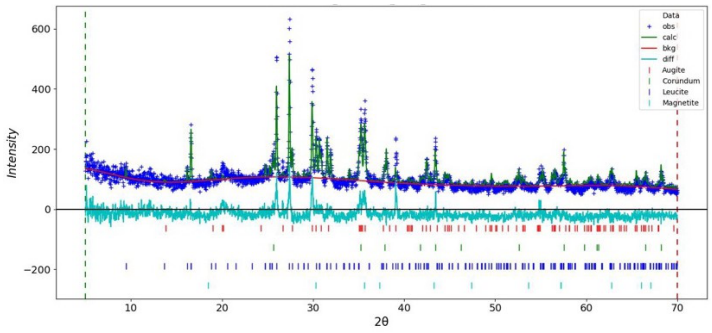


Figure 1: *Example of Rietveld refinement of one investigated NP.*

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