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ADVANCED SYNCHROTRON STUDIES OF YE'ELIMITE-BASED CEMENT PASTES

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Synchrotron characterization techniques [1] are being used to study Portland-based cements and recently also CSA and related cements. A key property of these techniques is that they do not require sample preparation, so the microstructures of the pastes can be preserved. The classical application of synchrotron tools is powder diffraction used to determine the crystalline phase content evolution with hydration including the overall amorphous fraction. Furthermore, other most advanced techniques are being applied to ye'elimite-containing pastes such as i) Total Scattering Synchrotron Powder Diffraction (TS-SXPD), and ii) Ptychographic Synchrotron X-ray Computed Tomography (PSXCT). All these applications will be reviewed here.

TS-SXPD data coupled with the Pair Distribution Function (PDF) analysis methodology [2] allows having a better insight about the nanocrystalline/amorphous atomic arrangements in the gels. It has been very recently shown that nanogibbsite with very small particles, $\approx 3\text{nm}$, is the main constituent of ye'elimite-gypsum hydration paste [2]. Nanogibbsite particles being smaller than those originated from the hydration of monocalcium aluminate. In addition, PSXCT is a tomographic technique that profits from the partly coherent nature of the synchrotron beam to provide better (smaller) resolution, which can be lower than 100 nm. It also provides the mass densities if the chemical stoichiometries are known. This technique has been applied to ye'elimite hydration to determine the microstructure and chiefly the bulk densities of nanogibbsite [3]. The microstructure evolution at early age was also followed [4]. Figure 1 shows an example of a slice of the electron density tomogram for a ye'elimite paste at 8 days of hydration and the corresponding histogram for the full volume with all phases identified. We highlight that it is possible to distinguish different hydrated phases which is not the case with standard (absorption-based) synchrotron X-ray computed tomography.

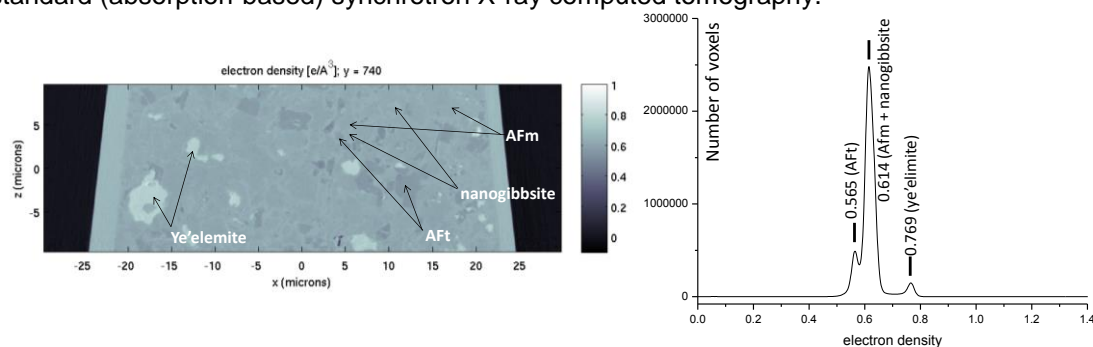


Figure 1: (Left) vertical slice of the electron density tomogram and (right) histogram of the electron densities for a ye'elimite paste at 8 days of hydration [3], as an example.

References

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