Proton NMR Characterization of First Sorption Cycle

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Objectives:
This research aims to understand and quantify changes in porous structure of different, controlled oxide mixtures of cement around fast and slow, partial and full de/sorption cycles by using Proton Nuclear Magnetic Resonance.

Pore Structue and Sorption Cycles

Mechanisms involved in the drying process are complex and are often interconnected. These are mainly due to the wide range of the pore size distributions in standard cement which determine, to a large extent, the different water transport mechanisms during the drying process. Durability of cement and concrete depends on its porous structure. Cement gel, as a colloidal, hydrophilic material, shrinks and swells with changes in moisture content.

Why use Proton Nuclear Magnetic Resonance (NMR)?

Proton NMR is non-invasive and non-destructive, so samples can be investigated in-situ. This method is an effective technique to characterize porosity and pore size distribution at a wide range of pore-sizes. It is possible to quantify the structural components of the cement paste including C-S-H, portlandite, ettringite, and water in several kinds of pores. In using different types of NMR experiments, it is also possible to analyze molecular diffusion, permeability, and sub-surface properties.

How does moisture content affect pore structure?

Reversible and irreversible changes to the microstructure of cement paste are a result of different phenomena acting simultaneously. It has been observed that the moisture content, measured by relative humidity, plays a role in affecting strong capillary forces, the ink-bottle effect, disjoining pressure, and surface tension.