

NMR measurements on cement

The four videos demonstrate insights that NMR can provide into the secrets of cement. NMR techniques developed by Peter McDonald ([link](#)) have been able to produce fundamental new insights to the structure and the hardening process of the world's most-produced substance. These four videos, span from the basic NMR background to the surprising insights gained.

<h2>1. The experiment</h2> <p>What happens inside the NMR machine?</p> <p>More NMR: Callaghan lecture series (flash only)</p>	<h2>2. The analysis</h2> <p>1. What do we learn from the experiment? (Reminder)</p> <p>Important: Intensity of a water population</p> <p>Normalized intensity (all water)</p> $\sum_i \frac{I_i}{\sum_j I_j}$ <p>→ Intensity becomes proportional to water content</p> <p>What will we learn? How to obtain these?</p> <p>C-S-H-Density and composition</p> $\text{Ca}_x(\text{Si}_y, \text{Al}_{1-y})\text{O}_{(2+0.5y+1.5x)}\text{H}_2\text{O}$
<h2>3. Drying and wetting</h2> <p>2. Porespace-resolved sorption (de)sorption isotherm</p> <p>Model for emptying gel pore</p> <p>Kelvin equation</p> $r_k = \frac{M(\text{H}_2\text{O})}{\text{RTP} \cdot \ln p} \quad r_k(90\% \text{ RH}) = 20 \text{ nm}$	<h2>4. Hardening</h2> <p>2. C-S-H properties</p> <p>1. Density</p> <p>2. C-S-H total formula</p> $\text{Ca}_x(\text{Si}_y, \text{Al}_{1-y})\text{H}_2\text{O}$ <p>3. C-S-H density</p> <p>2. C-S-H composition</p> <p>2a. C-S-H calcium content</p> <p>2b. C-S-H water content</p>

Further information:

Agata's thesis ([click here](#))

Arnaud's thesis ([click here](#))

The four videos are based on the PhD theses of Agata Gajewicz (Surrey) and Arnaud Muller (EPF Lausanne). Both students were supervised by Professor Peter McDonald (Surrey) and Professor Karen Scrivener (EPFL). The videos were made by Merlin Etzold (Surrey).