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Binding of NaCL during hydration of cement as observed by NMR

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With fresh water becoming scarcer, especially in developing countries, there is a tendency to use sea water for making concrete. Hence, more information on the effect of Na and Cl ions needed on the hydration. During the hydration both types of ions can be chemically bound to cement components, as hydrates are being formed [e.g., Friedel's salt Ca2Al(OH)6Cl2H2O]. Especially free chloride ions remaining at the end of the hydration can be dangerous, as they have the capacity to diffuse towards the steel bars of the reinforcement, resulting in corrosion.
Using a specially designed Nuclear Magnetic Resonance (NMR) setup, the 1H, 23Na and 35Cl content in cementitious materials can be measured. This setup makes use of a 4.7T magnet. Using a step motor the various inserts can be selected and the 1H, 23Na and 35Cl concentration can be measured quasi-simultaneously. In addition the relaxation of the nuclei can be used to obtain pore-size information, and thereby information on the pore-ion concentration distribution during hydration. In this study we have looked at the hydration of standard cement types, i.e., Portland CEM I and Blast furnace slag cement CEM III with a NaCl solution. The ratio of Na-to-Cl was measured during 48 hours. It is observed that the Na/Cl ratio changes during the hydration, indication a chemical/physical interaction with the cement matrix.

References

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