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The Potential of Nuclear Magnetic Resonance (NMR) to Non-Destructively Characterize Early-Age Concrete by an One-Sided Access (OSA) Technique

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Abstract

For in-situ inspection of concrete, there is generally a considerable pent-up demand in measuring non-mechanical quantities of building materials. Special interest applies to methods characterizing the properties of moisture storage and transport, because water influences nearly all damage processes in concrete. Determining these properties in-situ offers the possibility to describe the drying process in a component and to predict its sensitivity for pollutant absorption in order to prevent fatal damage in service-life of a construction. There is also a strong need for characterizing the very early life of concrete, when its strength develops and water binding processes are dominant. Hydrogen nuclear magnetic resonance (¹H-NMR) is an appropriate tool to determine water interactions with solid materials due to its sensitivity to hydrogen. Conventional NMR techniques are exclusively used as laboratory technique comprising a large, sophisticated instrumentation and requiring a detailed expert knowledge for operation. In contrast, „NMR-INSPECT” represents the worldwide first completely portable, battery-powered measuring system based on ¹H-NMR. It allows application from a single side to the specimen. At present, this is the only available method for completely non-destructive detection of depth-resolved water content and mobility. With this instrumentation it is possible to recognize the risk for a reduced residual life time of building materials at very early times. Besides it could help to accurately control concrete work (production and mixing) as well as to monitor workability and strength development after setting.