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How mobile is tritiated water through unsaturated cement-based materials? New insights from two complementary approaches

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Abstract

This work presents two complementary approaches (for low and high desaturation) to study tritiated water (HTO) diffusion through unsaturated cement-based materials. The first approach was based on through-diffusion experiments where suction was controlled by osmosis. In the second approach, diffusion experiments were performed in humidity chambers controlled by under-saturated saline solutions. Results revealed a decrease of effective diffusion coefficient by a factor of 10 from 100% to 23% of saturation degree. Comparison with gaseous H₂ suggests that HTO diffuses through unsaturated cement-based materials at rates 4 orders of magnitude lower.

Keywords:

Tritiated water (HTO); Diffusion; Cement; Desaturation; Osmosis; Saline solution

Highlights:

- Osmosis allows HTO diffusion experiments to be performed up to 9 MPa of suction
- Diffusive vapor exchange method enables the application of suction up to 170 MPa
- HTO mainly diffuses as dissolved species in solution in hardened cement paste
- Extent of irreversible HTO uptake on by cement-based materials increases with desaturation
- HTO diffuses 10 000 times slower through unsaturated cement-based materials than H₂ gas

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