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# UNDERSTANDING THE BEHAVIOUR OF MAGNESIUM POTASSIUM PHOSPHATE CEMENTS UNDER ALKALINE ENVIRONMENT

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## ABSTRACT

Magnesium potassium phosphate cements (MKPCs) are clinker-free acid-base binders that form through the reaction between magnesium oxide (MgO) and potassium dihydrogen phosphate (KH<sub>2</sub>PO<sub>4</sub>). In contact with water, dissolution and precipitation take place, mainly yielding K-struvite (MgKPO<sub>4</sub>·6H<sub>2</sub>O). MKPCs are of interest for patch repair work thanks to their fast setting and good adherence to old Portland cement (PC)-based concrete, but are also investigated for bioengineering, 3D printing and solidification / stabilization of hazardous waste. However, the understanding of their long-term evolution is still limited. Hence, this work aims at investigating the degradation mechanisms of MKPC paste under alkaline environment by considering two configurations: MKPC paste (*i*) in close contact with PC paste, or (*ii*) leached by an alkaline solution mimicking the pore solution of the PC paste.

MKPC (Mg/P molar ratio = 1) and PC pastes were prepared at a water-to-cement ratio of 0.51 and 0.4, respectively, and cured under endogenous conditions at 20°C for 28 d or 180 d. For the MKPC/PC paste interface study (*i*), two cylindrical samples were initially resaturated with their own synthetic pore solutions and maintained confined in a Hoek cell for 3 or 8 months. For the leaching study (*ii*), semi-dynamic leaching tests were carried out for 14 d and 170 d on MKPC monoliths using an alkaline solution which was periodically renewed to avoid accumulation of dissolved species. Leachates were analysed by ICP-AES. In both kinds of experiments, post-mortem characterization of the solids was performed using XRD, SEM/EDS and <sup>31</sup>P MAS-NMR.

Leaching induced a decrease in the content of crystalline K-struvite, as well as the precipitation of Ca-deficient hydroxyapatite (CDHA), brucite and possibly magnesium silicate hydrates. A thin layer of CDHA was also evidenced at the MKPC/PC paste interface and could explain the good bonding between these two materials.

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## KEYWORDS

Magnesium phosphate cement; Portland cement; Durability; Phase evolution; Leaching