Quantitative XRD analysis of the dehydration–hydration performance of (Na\(^+\), Cs\(^+\)) exchanged smectite

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ABSTRACT

The clay mineral membrane is increasingly used, as a natural geological barrier, in wastewater treatment. The variation of the environmental condition (T, P, RH, etc.) induces probably several change on the materials structure. This work aims at characterizing the link between dehydration–hydration behavior, charge location, and the ionic radius, in the case of dioctahedral smectites, exchanged with Na\(^+\) and Cs\(^+\) cation, which are occurred from industrial waste. A natural montmorillonite and beidellite, with different charge location (respectively, dioctahedral and trioctahedral), are selected. The exchange process is directed using Na\(^+\) and Cs\(^+\) cations. The hydration hysteresis is investigated “in situ” as a function of relative humidity condition rates. All samples are studied using quantitative X-ray diffraction (XRD) analysis. This method allows us to determine the structural parameters obtained from the theoretical mixed layer structure used to fit experimental XRD patterns. For both Na\(^+\) and/or Cs\(^+\) exchangeable cations, an increase in hydration heterogeneity degree for the tetrahedral substituted smectite layer is noted and the position of exchangeable Cs\(^+\) cation induce a homogeneous hydration trend which is interpreted by a new interlamellar space organization.

Keywords: Disordered systems; Liquid–solid reactions; Crystal structure; X-ray diffraction