Electric Charge and Surface Characteristics of Hydroxyaluminosilicate- and Hydroxyaluminum-Vermiculite Complexes

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Abstract: Hydroxyaluminosilicate (HAS) ions prepared from hydroxy-Al (HyA) ions and orthosilicic acid at different NaOH/Al molar and Si/Al atomic ratios were fixed in the interlayer spaces of vermiculite (Vt). The electric charge and surface characteristics of HAS-Vt and HyA-Vt complexes formed were investigated in the pH range of 4 to 8. At pH 4 to 6, the magnitude of negative charge (CEC) of HAS-Vt and HyA-Vt complexes was drastically reduced by a HAS- or HyA-interlayer formation of Vt. At pH 7 to 8, especially in NaOH/Al molar ratio of 2.5, the magnitude of negative charge was from 62 to 89% of CEC in untreated Vt, suggesting that part of HAS or HyA ions fixed on Vt was excluded from its interlayer spaces. The positive charge did not develop on HAS-Vt and HyA-Vt complexes at pH between 4 and 8. The fixation of HAS or HyA ions on Vt caused the significant reduction of its total and internal surface areas as well as the slight increase of its external surface area. The HAS- or HyA-fixation in the interlayer spaces of Vt was confirmed by X-ray diffraction analysis. Our results provided evidence of a possibility that Vt could fix HAS ions in the same way as HyA ions, transforming to chloritized-Vt. These interlayer materials could play a significant role in modifying the surface and mineralogical properties and cation exchange capacity of clays and soils.

Key Words: Electric charge characteristics • Fixation • Hydroxy-Al • Hydroxyaluminosilicate • Specific surface area • Vermiculite

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