Multi-step adsorption behavior of CTAB on Na-montmorillonite

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Spatial arrangement and distribution of hydrophobic surfactant on the clay minerals are key factors associated with loading capacity of water-insoluble drug molecules, drug release kinetics, and stability. This study aims to investigate the adsorption behavior of CTAB on Na-MMT and its interlayer arrangement in Na-MMT.

The multi-step adsorption beavior of CTAB was observed depending on the arrangement of CTAB within the layers (Fig. 1). Cationic CTA^+ molecules were intercalated into the interlayer spaces by cation exchange, while forming a lateral monolayer arrangement (region I in Fig. 1b). After forming lateral bilayer arrangement, physisorption was predominently occurred on the external surfaces (region II). It can be supposed that further CTA^+ uptake was inhibited by hydrophobic interlayer environment formed by bilayer arrangement, consequently leading to an accumulation on the external surface. Interestingly, further CTAB uptake was possible, supposedly by neutral CTAB molecules, leading to a paraffin-type bilayer arrangement after the adsorption reaction on the surface was equilibrated (region III). In particular, this phenomenon was promoted under high concentration of unreacted CTAB in the solution. Taking this aspect into consideration, it can be supposed that the adsorption process at region III was driven by diffusion.

Understanding the configuration and distribution of surfactant on the clay minerals from this research may provide a new insight into preparation of organoclays.

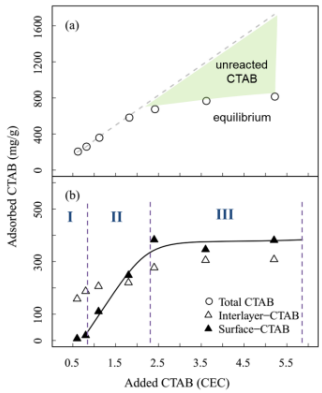

Figure 1. Multi-step adsorption isotherms of CTAB on Na-MMT; intercalation of cationic CTA^+ (I), accumulation of neutral CTAB on the external surface (II), and further intercalation of neutral CTAB (III).