Synthesis and characterisation of organoclays using single alkyl chain cationic surfactants - applications for water treatment

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Many different materials, especially clay minerals (Adebajo et al. 2003; Moazed and Viraraghavan 2005; Alther 2008) are widely used for oil remediation and removal of toxic chemicals from water. Clay minerals are effective adsorbents for water purification because of their high cation exchange capacity, swelling properties, and high surface areas. Organoclays are even more effective because of their hydrophobic nature. These clay mineral properties can be enhanced by converting montmorillonite to an organoclay by introducing cationic surfactant molecules into the interlayer space through ion exchange (Zhou et al. 2007). Intercalation of a cationic surfactant between the clay layers changes surface properties from hydrophilic to hydrophobic. In addition, modification of the swelling clay with a cationic surfactant increases the basal spacing of the layers. This investigation involves the synthesis and characterisation including X-ray diffraction, infrared and near-infrared spectroscopy of organoclays prepared using three single long chain alkyl cationic surfactants.

The molecular arrangement of the resultant clay interlayer has been studied as a function of surfactant concentration, based on the interlayer spacings obtained from XRD patterns. Significant changes in basal spacings and the XRD patterns of the organoclays are observed with increasing surfactant concentration. Infrared spectroscopy has been used to monitor and investigate the molecular structure of the modified clays using three specific regions of the infrared spectrum: 1) the hydroxyl bending region (around 1600 cm^{-1}), 2) the C-H stretching region (between 2950 and 2850 cm^{-1}), and 3) the hydroxyl stretching region (between 3700 and 3400 cm^{-1}). The shift in wavenumber of the CH stretching vibration has been used to determine the molecular environment of the surfactant molecules in the organoclay. The change of molecular structure which affects the surface property of the organoclay will be an important factor in water treatment.

References

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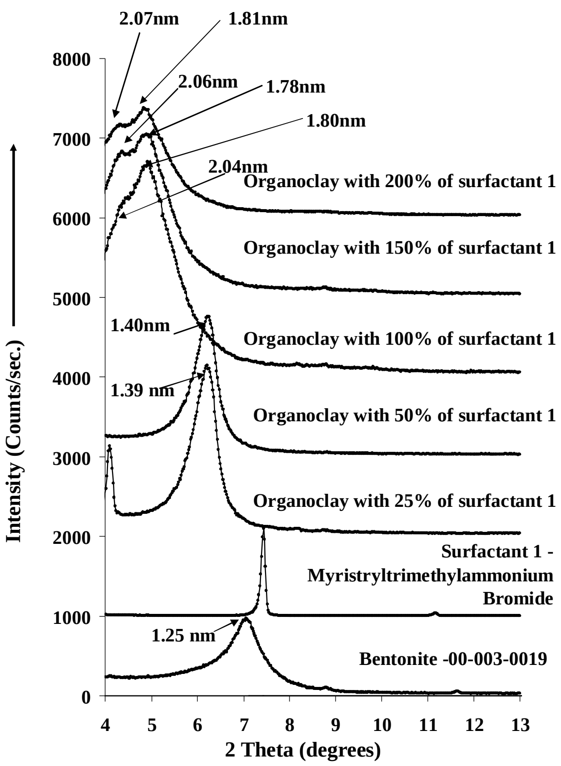

Fig. 1. XRD patterns of montmorillonite and the resultant organoclay prepared using Myristryltrimethylammonium bromide

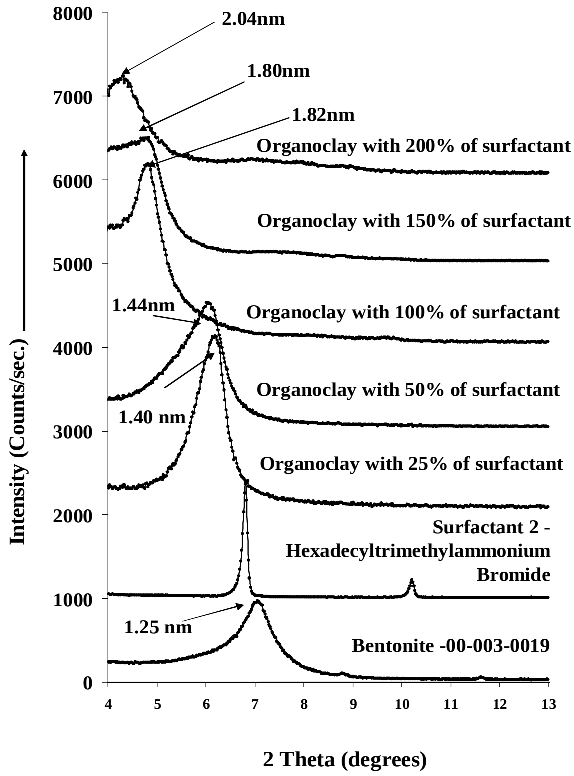

Fig. 2. XRD patterns of montmorillonite and the resultant organoclay prepared using Hexadecyltrimethylammonium bromide

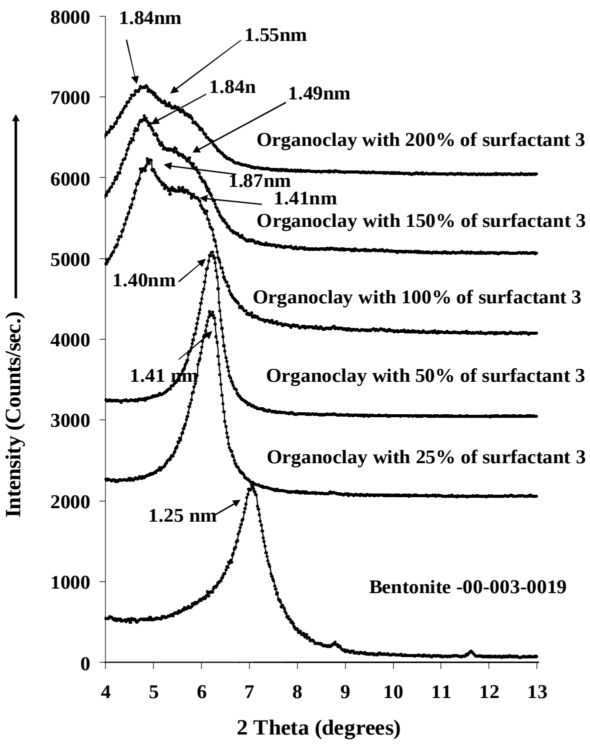

Fig. 3. XRD patterns of montmorillonite and the resultant organoclay prepared using Dodecyltrimethylammonium bromide