

ORGANO-MONTMORILLONITES FOR THE PURIFICATION OF WATER

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One of the major problems facing modern society is the lack of pure water. Many water storage systems are contaminated by a) microbiological and pathological organisms, b) organic molecules, c) toxic anions and d) heavy metals. One method of purification of the organic molecules which may include pesticides, herbicides, PCB's, is to adsorb the organic impurities on a hydrophobic filter. Organoclays which are formed through the ion exchange of the interlayer cation with a cationic surfactant form suitable hydrophobic filters. In this work we present detailed studies of the synthesis, characterisation and application of organoclays.

A detailed observation about the ordering conformation of hexadecyltrimethylammonium (HDTMA) ions confined within the montmorillonite interlayer in different concentration surfactant modified organo-montmorillonites has been obtained by X-ray diffraction, thermal analysis, SEM-TEM and spectroscopic techniques. Transmission electron microscopy (TEM), scanning electron microscopy (SEM) and X-ray diffraction (XRD) have been used to provide new insights into the interlayer structure and morphology of HDTMA⁺-montmorillonite hybrids (He et al., 2004). XRD patterns show that thermal treatment has an important effect on the stability of the surfactant intercalated in the hybrids, reflected by the significant changes of the basal spacing. TEM and SEM micrographs demonstrate that the hybrids with lower surfactant packing density are mainly composed of irregular layer stacking with a number of curved hybrid layers, while those with higher surfactant packing density are mainly composed of regularly interstratified and flat layers. The variation of the interlayer distances exists in all hybrids and is more obvious in the hybrids with lower surfactant packing density. This study demonstrates that not only the arrangement model of surfactant but also the morphology of hybrid strongly depend on the surfactant packing density within the montmorillonite gallery. X-ray diffraction has been used to study the changes in the surface properties of a montmorillonitic clay through the changes in the basal spacings of montmorillonite (SWy-2) and surfactant-intercalated organoclays. Variation in the d-spacing was found to be a step-function of the surfactant concentration. High resolution thermogravimetric analysis (HRTG) was used to study the thermal decomposition surfactant modified SWy-2-MMTs modified with the surfactant octadecyltrimethylammonium bromide. High resolution thermogravimetry shows the decomposition takes place in four steps. A mass loss step is

observed at room temperature and is attributed to dehydration of adsorption water. A second mass loss step is observed over the 87.9 to 135.5°C temperature range and is also attributed to dehydration of water hydrating metal cations such as Na⁺. The third mass loss occurs from 178.9 to 384.5°C and is assigned to a loss of surfactant. The fourth mass loss step is ascribed to the loss of OH units through dehydroxylation over the 556.01 to 636.35°C temperature range.

Many studies show that with the increase of the concentration of surfactant, the arrangement of surfactant in the clay interlayer will vary from lateral-monolayer, lateral-bilayer, paraffin-type monolayer and last to paraffin-type bilayer. In this study, the ordering conformation depends strongly on the concentration of the confined amine. In the sample with low amine concentration, the amine ions are parallel to the interlayer and individually separated (Dickey and Carron, 1996). The interaction among amine molecules is very weak. This dilution effect causes the formation of gauche conformers. However, with the increase of the amine concentration, increased interchain interaction and restriction of the room for the movement of the amine tail will be resulted. This will lead to the increase of the number of the ordered conformers which are reflected by the wavenumber shift to lower wavenumber and the decrease of the band width. For the paraffin-type model of the amine chains, there is a relative high packing density. This means the room for movement of the tail of amine chain is limited and the confined amine chains adopt an essentially all-trans conformation. Therefore, there will be no dramatic change of the wavenumber of the bands as demonstrated in the present study. It shows that both wavenumber and band width of antisymmetric and symmetric stretching modes are sensitive to the ordering conformation of the inserted organic surfactant cation. In addition, comparing with that of symmetric stretching mode, the wavenumber of the antisymmetric stretching mode is more sensitive to the mobility of the tail of amine chain.

References

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