

**ADSORPTION OF TRIBUTYLTIN(TBT) AND MONOBUTYLTIN(MBT) ON
KAOLINITE SURFACE: FOURIER TRANSFORM INFRARED (FTIR)
SPECTROSCOPIC STUDY**

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Butyltin compounds are widely used as stabilizing additives in polymers, biocidal reagents in various pesticides and as antifouling paintings. Due to its widespread industrial application, significant amounts of these pollutants enter the environment. Monobutyltin (MBT) and tributyltin (TBT) strongly adsorb onto clay mineral surfaces. In the present study, FTIR spectroscopy is used to determine interactions between the mineral and the adsorbed organotin compounds as well as the atoms, which are involved in the interactions between clay and organotin compounds. Adsorption experiments were carried out at pH 4, 6 and 8 for MBT and TBT.

Well crystallized, low layer charged kaolinite sample KGa, obtained from the Clay Mineral Depositors, Columbia, USA, was used as the sorbent material. Methanolic stock solutions containing each 2000 mg/l of tributyltin chloride (TBT, > 97 %) and monobutyltin trichloride (MBT > 95 %) from Merck, Darmstadt, Germany, were prepared. 1 g of dried sample KGa was suspended into 50 cm³ of deionized water in a screw-capped teflon flask. The suspensions were equilibrated for 24 h after adjusting the pH at desired values by the addition of required quantities of HCl(aq) or NaOH(aq). Any subsequent pH changes were corrected to an accuracy of ± 0.1 .

The attraction of TBT onto the kaolinite surface causes a strong reduction in the OH bending modes and the stretching vibrations of the Al(Si)-O lattice groups at wave numbers between 1400 to 800 cm⁻¹. However the OH stretching vibration modes at wave numbers 4000 to 3000 cm⁻¹ are not significantly affected. In contrast, the attraction of MBT molecules influences the stretching modes at 3667 and 3651 cm⁻¹ related to terminal OH groups. In addition, a strong increase of H-O-H vibrations at 1637 and 3470 cm⁻¹ can be observed, whereas the highest peak increase was found at pH 8 and the lowest at pH 4. These observations suggest that the different surface complexes are formed when MBT and TBT are adsorbed to the kaolinite surface. In case of TBT adsorption the molecule is bonded either by the formation of a mono-nuclear complex having monodentate configuration. In this case an oxygen atom of a Al(Si)-O lattice group is directly bonded to the Sn atom of a TBT molecule. The other possibility is the adsorption of TBT by interaction through hydrogen bonds. The type of surface complexation depends if TBT in solution appears in the form of a tetrahedron or in a trigonal bipyramidal configuration. MBT forms octahedral units in solution and is bonded to the kaolinite surface by hydrogen bonding. In this reaction the "outer hydrogen" groups of the clay minerals are involved.