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Correlating Antimicrobial activity and Structure in Montmorillonite modified withHexadecyltrimethylammoniumand Silver

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Abstract: The relationship between antimicrobial properties and structure of montmorillonite (MMT) containing hexadecyltrimethylammonium bromide (HDTMA-Br) and silver (Ag) was determined. HDTMA was adsorbed at the clay interlayer by a cation exchange, through the positive head of the ammonium group. At higher surfactant loadings (100 and 200% cation exchange capacity (CEC); MH1 and MH2 samples, respectively) the prevalence of weak adsorption (Van der Waals forces) was observed; whereas below the clay CEC (50%, MH0.5) strong interactions predominated (cation exchange). These different interactions impacted on antimicrobial activity, increasing bactericidal capacity when the surfactant was more available to diffuse. For organo-montmorillonites (OMMT) and all samples with Ag, zeta potential pointed out electrical charge changes on the outer surface, respect to MMT. XPS analyses showed peaks attributed to clusters formation, silver oxidation, and Ag^0 in MMT-Ag and MH0.5-Ag. The Ag^0 peak was also present in MH1-Ag and MH2-Ag, the later showing an extra peak associated with AgBr. $HDMTA^+$ and Ag adsorbed on the MMT acted synergistically against *Staphylococcus aureus*. This effect was less noticeable for *Escherichia coli* and the result was attributed to both, *E. coli* outer envelope which might lower the efficacy of $HDMTA^+$ adsorbed on the MMT, and decreasing silver proportions when the surfactant loading increased. MH1-Ag presented the best bactericidal properties, showing synergistic effects against *S. aureus*, while maintaining activity against *E. coli* compared to MMT-Ag. Understanding MMT-HDMTA-Ag efficacy contributes to the design of new antimicrobial materials for potential applications in health care.

Key words : Synergistic bactericidal activity, *Staphylococcus aureus*, *Escherichia coli*, Modified montmorillonite, Hexadecyltrimethylammonium, Silver.

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