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Synthesis, characterization and bactericidal assessment of MgO polymeric fiber nanocomposites for water disinfection

Abstract

The increasing number of antimicrobial resistant infectious diseases has generated great interest in the development of new antimicrobial agents. Metal oxide nanoparticles are among those.

Metal oxide nanoparticles such as Magnesium oxide (MgO Np) exhibit broad spectrum antimicrobial activity even in light deprived environments. MgO is stable under harsh process conditions, easy to synthesize from multiple sources and routes, it is also considered harmless to human beings.

Despite the promising antimicrobial properties of MgO Np, the recovery from aqueous environments remains as a limiting factor for its use as water disinfectant. In consequence, the immobilization of MgO nanoparticles in polymeric supports is a feasible solution to overcome this limitation.

In this work, MgO nanoparticles were synthesized and incorporated into Polyacrilonitrile (PAN) nanofibers via electrospinning. The resulting electrospun composite membranes were used as disinfectant in the treatment of wastewater.

The antibacterial capability of the electrospun membranes containing 10% MgO Np against Gram-negative bacteria and *Streptococcus* was assessed by the plate spread method. Membrane samples of 0.150g, 0.200g and 0.250g were used in the treatment of 10.0 mL of wastewater. This treatment was conducted for 6 hours in an incubated reciprocating shaker at 37⁰C. An aliquot of 500.00µL of water was extracted every two hours and plated in selective agar for bacteria colony counting after 24 hours of incubation at 37⁰C.

PAN-10% MgO electrospun membranes in a dose of 0.150g/10.0 mL of water completely inhibited the growth of Gram-negative bacteria and *Streptococcus* after two hours of treatment. Otherwise, PAN-0% MgO membranes contribute to bacteria proliferation when compared to untreated water samples.

These results were compared to the exhibited by Alginate-50% MgO composite beads, which were not as effective as electrospun membranes. Alginate beads in a dose of 0.125 g/10.0 mL of water reached 86.5 % growth inhibition for gram negative bacteria and 90.2 % growth inhibition for streptococcus after two hours of treatment.

These results indicate that electrospun membranes are a suitable support for MgO nanoparticles immobilization, which allows its practical use for water disinfection.

Ciencias de materiales

Ciencias de la Salud

Energía y medio ambiente

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