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Abstract

Chitosan-Based Bactericidal Interpenetrated Hydrogels †

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Bactericidal interpenetrated hydrogels have become a popular topic in recent years due to their unique properties, with potential applications in wound-healing devices [1], controlled release of drugs or the release or retention of nutrients from soil [2]. Therefore, there have been numerous reports focused on the improvement of the design and synthesis of these hydrogels for the ideal interpenetrated material with bactericidal properties. Consequently, the goal of the current study is to obtain a series of new polymer networks with interpenetrated structures using commercial chitosan (CC)/chitosan synthesized from commercial chitin (CCH) and vinyl benzyl-trimethylammonium chloride (VBTAC), a quaternary ammonium salt used for its excellent bactericidal properties [3,4]. The new hydrogels were physico-chemically characterized by infrared spectroscopy (FTIR) to determine the composition and by thermo-gravimetric analysis (TGA/DTG) to study the thermal behavior. Additionally, the swelling degree (SD%) and the potential bactericidal effect of the hydrogels were investigated in order to determine the influence of the type of chitosan used in the interpenetrated network. The interpenetrated hydrogels were synthesized by radical polymerization using CC/CCH, VBTAC monomer, variable concentrations of N,N′-methylenebisacrylamide (MBA) as a crosslinking agent and a radical initiator. Acetic acid and distilled water were used to prepare the chitosan solutions. The obtained results showed that the type of chitosan influenced the swelling degree for each hydrogel. In the case of hydrogels with less MBA, differences between the values of the maximum SD% were observed. This showed that a higher concentration of crosslinker leads to much more rigid polymer networks, which prevents the absorption of larger amounts of water. The FTIR and TGA/DTG analyses indicated the presence of chitosan, indicated by characteristic peaks in the infrared spectra and characteristic degradation stages in thermal analysis, respectively. Bactericidal tests reflected the potential of the synthesized materials, especially the hydrogel based on CCH, to destroy both coliforms and clostridia in high proportions. This study describes the successful synthesis of interpenetrated hydrogels by radical polymerization based on commercial chitosan, chitosan synthesized from commercial chitin and quaternary ammonium salts. The physico-chemical characterization of the new materials indicated the presence of the compounds of interest, showing no degradation in the chemical structures. The bactericidal investigation confirmed the potential of the materials in removing coliforms and clostridia from effluent waste waters, particularly for materials based on chitosan synthesized in the laboratory.

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