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Effect of vinyl montmorillonite on the physical, responsive and antimicrobial properties of the optimized polyacrylic acid/chitosan superabsorbent via Box-Behnken model

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Abstract

This work aims to study the effect of a vinyl-modified montmorillonite (VMT) on the physical and antimicrobial properties of chitosan-graft-polyacrylic acid superabsorbent (Ch-*g*-PA). Ch-*g*-PA was first optimized using Box-Behnken Design to obtain the maximum equilibrium swelling, and the model was efficient to express the experimental swelling data (R^2=0.999). VMT was further added to the optimized Ch-*g*-PA in different contents 0, 4, 7 and 10 wt%. FTIR confirmed the successful synthesis of the copolymers and their nanocomposites. Morphology and the average pores size were studied using SEM. Wide angle X-ray diffraction showed the formation of exfoliated nanocomposites after VMT addition. Thermal stability studied by TGA was greatly enhanced in the presence of VMT. The Swelling kinetics by Voigt-based viscoelastic model showed that the equilibrium swelling was increased by increasing the VMT up to 7 wt% then decreased after further incorporation. The superabsorbents exhibited salt and pH-responsive properties and showed a pH-reversibility at two buffer solutions (pH 2 and 9). Moreover, the prepared superabsorbents exhibited a strong bacterial and fungal killing ability which becomes more pronounced upon increasing the VMT content. The obtained results encourage the usage of the prepared copolymer nanocomposites in many fields as antimicrobial superabsorbents of improved physical properties.

Keywords: Superabsorbents; Box-Behnken; Responsive properties

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