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Abstract

Hybrid Cryogels with Advanced Adsorbent Properties for Penicillin †

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In recent years, natural polymers (chitosan and biocellulose) have sparked interest, especially when it comes to medical uses (wound healing, excipients for drug administration), due to their great biocompatibility and low toxicity [1–3]. However, the poor mechanical properties of chitosan limit its use to some extent. For this reason, in this study, chitosan was used in a mixture with a natural clay, i.e., kaolin. The choice of kaolin was made considering both its low toxicity and the occurrence of hydroxyl groups, which make it suitable for hybrid cryogels with advanced adsorbent properties. Since 1941, penicillin has been used to cure infectious diseases, but it may be also involved in food preservation. The presence of antibiotic residues in wastewater poses toxicity issues, requiring measures to reduce this pollution effect [4,5]. In this study, hybrid super-adsorbent cryogels were developed, capable of retaining penicillin from aqueous samples. In order to develop the desired hybrids, two types of chitosan were used: commercial chitosan (CC) and chitosan prepared in a laboratory from shrimp shells (CS). Other reagents were as follows: acetic acid, used in a mixture with water, for chitosan dissolution; a crosslinking agent; kaolin; γ-methacryloxypropyltrimethoxysilane, the organophilization agent; and penicillin G, the antibiotic. The issues related to the rather limited compatibility between inorganic kaolin and organic chitosan require organic modification of kaolin, in which case MAPTES was used. In order to confirm the organophilization and the structure of super-adsorbent materials, samples were characterized using various modern techniques (FTIR, BET, SD, UV-Vis). FTIR spectra confirmed the occurrence of characteristic bands of the involved raw materials. The developed hybrids possess adjustable porosity according to BET. The UV-Vis results confirmed that hybrid cryogels posed great retention capacity for penicillin in aqueous solutions.

Innovative super-adsorbent cryogels based on natural polymers and clays were successfully prepared. These materials showed great adsorption capacity, mainly because of the high swelling capacity of chitosan. The use of kaolin yielded improved mechanical properties.

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