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Synthesis, spectroscopyc, kinetic, and hydrophilic characterization of nanocomposite hydrogels containing layered double hydroxide nanoparticles

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Recently, hydrogels have received significant interest from academic and industrial sectors due to their biodegradability, biocompatibility, non-toxicity, and hydrophilic properties. Additionally, incorporating polysaccharides and inorganic nanoparticles into a polymer matrix improves these properties, thus enabling a wide application in several areas. This work aims to synthesize and evaluate the spectroscopic properties, kinetic parameters, and hydrophilicity of novel nanocomposite hydrogels containing different concentrations of layered double hydroxide nanoparticles intercalated with acetate anions (LDHac). The nanocomposite hydrogels were synthesized from the solution containing acrylamide, carboxymethylcellulose, and LDHac at different concentrations (1-10 %). The hydrophilic results indicated that all samples reached the equilibrium swelling stage after 32 hours. It is also noted that the increase of LDHac in the hydrogel matrix decreases its hydrophilicity from 32.5 ± 0.72 g/g to 20.7 ± 0.17 g/g for the hydrogels without LDHac and with 10 % LDHac, respectively. The kinetic parameters showed an anomalous transport mechanism ($0.45 < n < 0.89$) independent of the hydrogel composition. On the other hand, the diffusion coefficient (k) increased with the increase of LDHAc content, indicating an increase in the water absorption speed. These results suggest that the LDHAc acted as a physical and/or chemical crosslinker, decreasing the polymeric chain's elasticity and, consequently, the swelling of the samples. However, the rigidity of the chains contributes to improving the velocity of the water uptake. In the spectroscopic analysis of the nanocomposite hydrogels, a discrete peak at 1384 cm-1 referring to the NO flexion vibration of NO3- anions (coming from no complete acetate-exchange process ~ 79 %) was observed, confirming the presence of the LDHac in the hydrogel matrix. Therefore, these results indicate that the presence of LDHac influences the kinetic parameters and hydrophilic properties of the hydrogel nanocomposites, making it possible to control their capacity and velocity of water uptake according to the LDHac concentration, increasing its technological application.