FREEZE-THAWED PVA/KAOLINITE NANOCOMPOSITE HYDROGELS: PREPARATION, CHARACTERIZATION AND MECHANICAL PROPERTIES

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Abstract

Freeze-thawed nanocomposite hydrogels were prepared on the basis of polyvinyl alcohol (PVA) containing 0, 5, 10, and 15 wt.% of kaolinite (based on the dried hydrogel). The micro-structure of nanocomposite was investigated using the X-ray diffractometry (XRD) and transmission electron microscopy (TEM) techniques. Intercalated morphology was observed for all prepared nanocomposite hydrogels. The effect of kaolinite on the mechanical properties of PVA/kaolinite nanocomposite hydrogels was studied using uniaxial tensile test (ASTM D-1822-99), dynamic mechanical thermal analysis (DMTA), and hardness measurement. Remarkable increases on the tensile modulus and tensile strength were observed for the nanocomposite hydrogels, e.g. 228 and 131 % increases were achieved in tensile modulus and tensile strength by incorporating 15 wt.% of kaolinite into PVA hydrogel, respectively. The DMTA test was performed in the compression mode, using disc-shaped samples with a diameter of 11 mm and a thickness of 5 mm. It was shown that the storage modulus of PVA hydrogel increases by increasing the kaolinite content. The storage modulus of nanocomposite hydrogel containing 15 wt.% of kaolinite in the regions below and above 0 °C were on average 210 and 140 % higher than of pure PVA hydrogel, respectively. The results also showed that the hardness is directly depended to the quantity of kaolinite added to the nanocomposite hydrogel.

Keywords: Nanocomposite hydrogel, Kaolinite, Polyvinyl alcohol, Mechanical properties, Freezing-thawing

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