One-step preparation of woven fabric-reinforced hydrogel composite

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Abstract

Cotton-woven fabric-reinforced polyvinyl alcohol-based hydrogel composite was produced by constructing cotton as warp and polyvinyl alcohol/cotton hybrid and polyvinyl alcohol yarns as weft yarns in the fabric structure. As-prepared polyvinyl alcohol/cotton fabrics were treated with different concentrations of aqueous borax and glutaraldehyde crosslinking solutions. Polyvinyl alcohol molecules were transformed to crosslinked gel structure after the treatments. Since cotton yarns kept their yarn structure in the fabrics, woven fabric-reinforced hydrogel composites were obtained. Chemical analysis to investigate crosslinking was conducted by attenuated total reflection-Fourier transform infrared spectroscopy spectra analysis, and the results revealed that a proper crosslinking of polyvinyl alcohol molecules in polyvinyl alcohol yarns occurred by using both borax and glutaraldehyde as crosslinkers. Thermal stabilities of the samples were observed via thermogravimetric analysis measurements. Even though borax crosslinking increased the thermal stability, glutaraldehyde crosslinking did not have a significant effect on the thermal stability of hydrogel composite. Crystalline microstructural analysis was carried out with X-ray diffraction measurement. Tensile properties of the samples by focusing on the crosslinker ratio and water contents in the hydrogel composites were performed. The results revealed that tensile properties of hydrogel composite tremendously increased with fabric reinforcement. Also, breaking force gradually increased when the hydrogel composite structure released the water from its structure at both borax and glutaraldehyde samples. Since the produced fabric-reinforced hydrogel composites have high strength, they are promising candidates as hygroscopic materials for planting and erosion control at inclined terrains.

Keywords

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