

Synthesis and properties of vinylpyrrolidone / (trimethoxysilyl) propyl methacrylate gels containing different amounts of crosslinking agent

ABSTRACT

High conversion copolymers containing 90 wt % of N-vinylpyrrolidone (NVP) and 10 wt % of 3-(trimethoxysilyl)propyl methacrylate (TMSPM) with 0, 1, 2, 3 and 4 wt % (in conversion to mass of NVP/TMSPM) of ethylene glycoldimethacrylate (EGDMA) as crosslinker have been successfully synthesized. Proton nuclear magnetic resonance ($^1\text{H NMR}$) and Fourier transform infrared spectroscopy (FT-IR) were employed to characterize the resulting copolymers. The effect of EGDMA amount on the mechanical and thermal properties, swelling parameters, clarity, and oxygen permeability of the prepared xerogels and hydrogels were studied. 3 wt % of EGDMA is required to obtain clear xerogels and hydrogels. The water content (EWC), volume fraction of polymer (ϕ_2) and weight loss during swelling decrease with increasing EGDMA content. Young's and shear modulus (E and G) increase as EGDMA content increases, the values of E and G are 0.570–3.531 MPa and 0.217–1.359 MPa, respectively. The hydrogels were characterized in terms of modulus crosslinking density (ν_e and ν_t) and polymer-solvent interaction parameters (χ). The results are 0.220–0.613 mol/dm³ for ν_e , 0.105–0.441 mol/dm³ for ν_t , and 0.595–0.822 for χ . Thermal properties enhance by adding EGDMA whereas the oxygen permeability (P) of hydrogels decreases from 48.6 to 44.3 as water content decrease from 70.3 to 55.1.

Keyword: High conversion copolymers; Swelling parameters; Mechanical properties; Oxygen permeability; Crosslinking density