

Thermo-Elastic and Self-Healing Polyacrylamide: 2D Polymer Composite Hydrogels for Water Shutoff Treatment

Authors : Edreese H. Alsharaeh, Feven Mattews Michael, Ayman Almohsin

Abstract : Self-healing hydrogels have many advantages since they can resist various types of stresses, including tension, compression, and shear, making them attractive for various applications. In this study, thermo-elastic and self-healing polymer composite hydrogels were prepared from polyacrylamide (PAM) and 2D fillers using in-situ method. In addition, the PAM and fillers were prepared in presence of organic crosslinkers, i.e., hydroquinone (HQ) and hexamethylenediamine (HMT). The swelling behavior of the prepared hydrogels was studied by hydrating the dried hydrogels. The thermal and rheological properties of the prepared hydrogels were evaluated before and after swelling study using thermogravimetric analysis, differential scanning calorimetric technique and dynamic mechanical analysis. From the results obtained, incorporating fillers into the PAM matrix enhanced the swelling degree of the hydrogels with satisfactory mechanical properties, attaining up to 77% self-healing efficiency compared to the neat-PAM (i.e., 29%). This, in turn, indicates addition of 2D fillers improved self-healing properties of the polymer hydrogel, thus, making the prepared hydrogels applicable for water shutoff treatments under high temperature.

Keywords : polymer hydrogels, 2D fillers, elastic self-healing hydrogels, water shutoff, swelling properties

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