7th International Conference of Multidisciplinary Approaches (iCMA), 2020
Faculty of Graduate Studies,
University of Sri Jayewardenepura,
Sri Lanka.
ISSN: 2386 – 1509

DEVELOPMENT OF ACRYLAMIDE HYDROGEL HAVING FAST RESPONDING TIME AND HIGH MECHANICAL STRENGTH

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Abstract

Porous polymer hydrogels existed in nature as a unique material since life on earth. Among them, acrylamide hydrogels are affirming materials as unique biomaterials since they intrinsically possess high biocompatibility, flexibility and large water content owing to their hydrophilic, three-dimensional network structures. Hydrogels generally are having an enormous potential to be utilized as prime candidates for various applications including biosensors load-bearing engineering tissues, and drug delivery vectors. In spite of being the most prominent biomaterials for various biomedical applications, their weak mechanical performance is a considerable drawback for apply in particular applications that require excellent mechanical properties. This work highlighted a novel approach on developing highly porous, fast swelling hydrogels having high mechanical performance by twisting the traditional double network concept. A hydrogel was developed using acrylamide as the monomer, and N,N-methylenebisacrylamide (N-[(Prop-2-enoylamino)methyl]prop-2-enamide) as the cross-linker, and potassium persulphate as the initiator. The developed hydrogel structure consists of micrometer size pores while having an ultimate compressive strength of 7.070 ± 0.135 MPa, swelling ratio of 13.40 ± 0.83 times with respect to the dried hydrogel within the first 30 minutes and the initial swelling rate of 3.945 ± 0.23 min^{-1} in the first two minutes. While single network hydrogels display an ultimate compressive strength of 0.387 ± 0.19 MPa, swelling ratio of 11.52 ± 0.64 times with respect to the dried hydrogel within the first 30 minutes and the initial swelling rate of 0.86 ± 0.015 min^{-1} in the first two minutes. Such enhanced properties of the developed double network hydrogel are due to the surface roughness of interconnected capillary channels. The developed hydrogel could swell faster than single network hydrogel via efficient capillary action. The unique coalition of mechanical properties of highly porous double network hydrogel may initiate novel explorations of hydrogels in various biomedical applications.

Keywords: Biomaterials, porous, swelling, strength, hydrogel