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Fabrication of novel acrylic-based hdrogel for controlled release of organic and inorganic fertilizers

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A novel terpolymeric hydrogel system composed of methacrylate (MA), vinylacetate (VA) and acrylic acid (AA) chemically crosslinked with Diethylene Glycol Dimethacrylate (DEGDMA) was studied for its application in the field of controlled relaease fertililizers. Two inorganic agrochemicals, ammonium nitrate (AN), potassium nitrate (PN) and one organic fertilizer, urea were selected as test chemicals to study the efficiency of the hydrogel. The copolymeric hydrogels were characterized through Fourier transform infrared (FTIR), Differential scanning calorimeter/ thermal gravimetric analyses (DSC/TGA) and Scanning electron microscopy (SEM). During swelling studies, it was found that the media penetration velocity and equilibrium media content changed adversely with the crosslink density. The pH of loading medium shifted the swelling mechanism from Fickian ($n<0.5$) to non-Fickian ($n>0.5$) behavior. The crosslink density also decreased the Molecular weight between cross links, Mc, and m esh size, ξ. The percentage loading capacity of hydrogel was found to be higher for inorganic chemicals (70 % for PN and 71.1% for AN) than that of Urea with loading percentage of 42.56-61.5. Extensive release studies of Urea indicated that the cumulative release of Urea could be controlled by changing its initial concentration in the loading medium and the acrylic acid component in the hydrogel. The release of Urea was also studied in soil solution and it was found that the ions present in the release medium highly affect the cumulative release amount of the fertilizer slowing down its release rate as compared to that in the deionized water. Moreover, mostly the hydrogels exhibited a non-Fickian type release behavior with the diffusion exponent (n) having value greater than 0.5..The promising response these hydrogels to the external pH, a reasonable agrochemical loading capability, optimum release capacity, first order release kinetics and favorable swelling behavior indicate that these hydrogel systems may be used, not only, as good controlled release fertilizer (CRF) but may also be helpful to enhance the water absorption capacity of soil alongwith avoiding soil erosion phenomenon in the best possible way.

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