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ORIGINAL PAPER

New routes to prepare superabsorbent polymers free of acrylate cross-linker

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Abstract In this study, new series of superabsorbent polymers, which were free of acrylate cross-linkers, were synthesized and their absorbent properties were evaluated. The new superabsorbent polymers showed high free swell and absorbency under loading. They were synthesized in a single-step process through a solution polymerization of partially neutralized acrylic acid in the presence of cross-linking agents allyl sucrose (AS) and epoxy allyl sucrose(EAS). Allyl sucrose was synthesized by reacting sucrose with allyl chloride in an alkaline medium. Allyl sucrose was then converted into EAS by oxidation with peracetic acid. The synthesis and absorbent properties of superabsorbent polymers (SAPs) cross-linked with commercially available non-sucrose-based epoxy cross-linking agents, e.g., glycerol diglycidyl ethers (GDGE), 1,4-butanediol diglycidyl ether (1,4-BDGE) and 1,4-cyclohexanedimethanol diglycidyl ether (1,4-CHDDMDGE) have been evaluated, as well. Absorbent properties of the prepared superabsorbent polymers were evaluated in saline solution and results showed high dependency of the absorbent properties on the cross-linking agent polarity and concentration. Superabsorbent polymers cross-linked with EAS and GDGE showed the highest absorbency under loading and indicated that they formed gels with high strength in the aqueous solution. Absorbent properties of the prepared SAPs showed reversible correlation with cross-linking agent concentration. The pH of the reaction mixture was optimized to achieve the highest free swell and absorbency under loading. The biodegradation properties of the superabsorbent polymers cross-linked with sucrose-based cross-linking agents were also evaluated and they showed degradation behavior under the influence of organisms *Pseudomonas aeruginosa* and *Trichophyton rubrum*.

Keywords Superabsorbent polymer · Polyacrylic acid · Allyl sucrose · Epoxy allyl sucrose · Cross-linking agent · Gel

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Introduction

Superabsorbent polymers (SAPs) are defined as highly polar hydrogels that can absorb and retain large amounts of water or aqueous solutions [1, 2]. The hydrogels have the ability to absorb deionized water as high as 10–1000 g water/g SAP. The first commercial SAP was developed 40 years ago by alkaline hydrolysis of starch-graft-polyacrylonitrile (SPAN) [3, 4]. Since then, the applications of superabsorbent polymer have grown extensively. They are currently used in a wide array of applications, which include personal disposable hygiene [5, 6], agriculture [7, 8], biomedical applications [9], food [10],