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Synthesis and application of acrylamide/sodium vinylsulfonate/carboxymethylcellulose/zeolite hybrid hydrogels as highly swollen effective adsorbents for model cationic dye removal

Erdener Karadağ*, Belgin Yel, Semiha Kundakcı, Ömer Barış Üzüm

Adnan Menderes University, Fen-Edebiyat Faculty, Chemistry Department 09010 Aydın, Turkey, Fax: +90 256 2135379; emails: ekaradag@adu.edu.tr (E. Karadağ), belginyel@hotmail.com (B. Yel), skundakci@adu.edu.tr (S. Kundakcı), ouzum@adu.edu.tr (Ö.B. Üzüm)

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ABSTRACT

This report investigates the equilibrium swelling and dye sorption properties of a series of a novel hybrid/biohybrid composite hydrogel sorbent systems containing polysaccharide/zeolite polyelectrolyte based on acrylamide/sodium vinylsulfonate and carboxymethyl cellulose, and a mineral component such as zeolite. Novel hydrogels were synthesized with free radical solution polymerization by using ammonium persulfate/*N,N,N′,N′*-tetramethylethylenediamine as redox initiating pair in the presence of poly(ethylene glycol) diacrylate as a crosslinker. Swelling experiments were performed in water at 25°C, gravimetrically. The hydrogels, the semi-interpenetrating polymer networks, and the hybrid/biohybrid composite hydrogel systems that synthesized in this study have showed high swelling performance. The swelling and diffusion properties were calculated, and discussed for the hydrogels prepared under various formulations. The equilibrium swelling factor of the hydrogel systems ranges were 6.61–31.97. Fourier transform infrared spectroscopy analysis and scanning electron microscopy technique were applied for structural characterization. For sorption of water-soluble cationic dye such as "methyl violet" into the hydrogel systems was studied by batch sorption technique at 25°C. For equilibrium sorption studies, dye sorption percentage, dye uptake performance, and partition coefficient of the hydrogels have been investigated. The values of dye sorption percentage were changed among 53.12%–88.60%. Consequently, the hydrogel systems developed in this study could serve as a potential sorbent device for water and dye (and/or similar model molecules) sorption.

Keywords: Acrylamide/sodium vinylsulfonate; Biohybrid hydrogel; Swelling; Dye sorption; Methyl violet; Carboxymethyl cellulose; Zeolite

* Corresponding author.