Temperature-induced adsorption and desorption of phosphate on poly(acrylic acid-co-N-[3-(dimethylamino)propyl]acrylamide) hydrogels in aqueous solutions

Baiyou Liu*, Huayong Luo*, Hongwei Rong*, Xueyang Zeng*, Kelin Wu*, Zuhao Chen*, Hanxing Lu*, Dongchuan Xu*

*School of Civil Engineering, Guangzhou University, Guangzhou, 510006, China, Tel. +86 20 39366657, Fax +86 20 39366657, email: liubaiyou94@163.com (B. Liu), lhy0909@gzhu.edu.cn (H. Luo), gzdxrhw@163.com (H. Rong), 183362493@qq.com (X. Zeng), 522959062@qq.com (K. Wu), 493947832@qq.com (Z. Chen), 476448531@qq.com (H. Lu),

School of Harbin Institute of Technology, Harbin, 150000, China, email: 15161777@qq.com (D. Xu)

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ABSTRACT

We explore the feasibility of using thermosensitive hydrogels based on copolymers of acrylic acid (AAC) and N-[3-(dimethylamino)propyl]acrylamide (DMAPAA) [P(AAC-co-DMAPAA)] for adsorption and desorption of phosphate in aqueous solutions by a temperature swing. The hydrogels were protonated when they swelled in acidic solution at room temperature, exhibiting good adsorption capacity of phosphate. The phosphate ions were desorbed at high temperature due to the ionic repulsion of carboxyl groups caused by the dissociation of hydrogen bonding. The hydrogels were characterized by Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM) and thermogravimetric analysis (TGA). The effects of solution pH and temperature on phosphate removal were investigated. Kinetic data revealed that the adsorption of phosphate fitted the pseudo-first-order model. Isotherm data showed that the Freundlich model was more suitable than the Langmuir model. Effective desorption of phosphate was observed by raising the solution temperature to 55°C, and repeated adsorption and desorption behaviors were achieved within three consecutive cycles by a temperature swing between 25°C and 55°C. These findings suggest the possible phosphate removal and recovery from aqueous solutions by changing the environmental temperature.

Keywords: Thermosensitive; Hydrogel; Adsorption; Desorption; Phosphate

*Corresponding author.