



Poly(methacrylic acid) based hydrogels as sorbents for removal of cationic dye basic yellow 28: Kinetics, equilibrium study and image analysis

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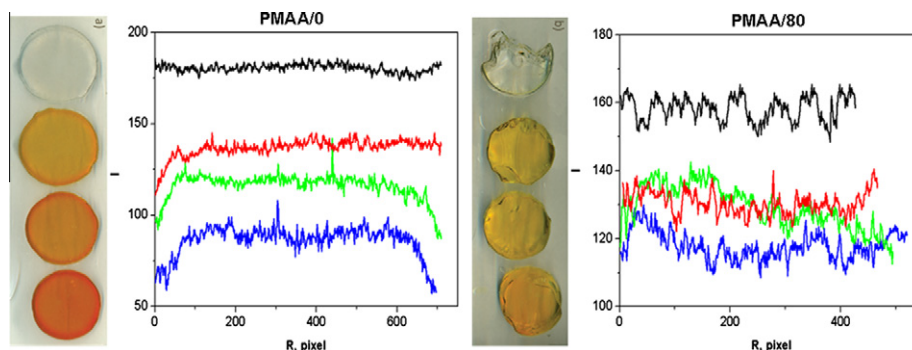
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HIGHLIGHTS

- pH sensitive PMAA hydrogels are used as low-cost sorbents for cationic dye removal.
- Sorption kinetic, equilibrium, thermodynamic and image analysis experiments are done.
- Sorption data reveal spontaneous, favorable, endothermic process.
- Image analysis indicates heterogeneous coloration along hydrogel diameter.
- The saturated sorption amount of BY28 on PMAA/80 hydrogel can reach up to 157 mg/g.

GRAPHICAL ABSTRACT



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ABSTRACT

Poly(methacrylic acid) based hydrogels with neutralization degree of monomer of 0% (PMAA/0) and 80% (PMAA/80) were synthesized and their sorption potentials toward model cationic dye, basic yellow 28 (BY28), from aqueous solution, were investigated. FTIR and SEM analysis were conducted to confirm the structure and morphology of the sorbents. Investigation of the effect of the initial dye concentration, the solution pH, the sorbent mass and the temperature on sorption process, as well as the sorption kinetics and equilibrium studies were performed by batch technique. Sorption capacities of both sorbents showed to be highly sensitive to external conditions change, especially those affecting hydrogel swelling degree. Kinetic studies showed that the pseudo-first order kinetic model well fitted the experimental data and that sorption of BY28 onto PMAA hydrogels could be very well described with phase-boundary controlled models. Thermodynamical data revealed spontaneous endothermic processes. In case of PMAA/0 hydrogel physisorption was dominant, while in case of PMAA/80 hydrogel, both, the physisorption and chemisorption were presented. Langmuir, Freundlich and Dubinin–Radushkevich sorption isotherms were applied on equilibrium sorption data. The saturated sorption amount could reach up to 102 mg g⁻¹ and 157 mg g⁻¹ for PMAA/0 and PMAA/80 hydrogel, respectively. Image analysis proved to be useful method for analysis of uniformity of coloration along the hydrogel diameter. Both hydrogels displayed good properties in cationic dye removal, but higher sorption capacities, percentage of removed dye and significant acceleration of sorption of BY28 were accomplished by neutralizing the monomer up to 80%.

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1. Introduction

Water pollution by toxic industrial waste is one of the most serious social and ecological issues of today. The use of dyes in expanding industries of textile, polymers, food and pharmaceuticals

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