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Sepiolite Embedded Nanocomposite Cryogels for Heavy Metal Removal from Aqueous Solutions

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Extended Abstract

Sepiolite is a natural clay mineral with a unit cell formula of magnesium hydrosilicate ($Mg_4Si_6O_{15}(OH)_2 \cdot 6H_2O$). This unique fibrous structure with interior nano-channels and its high surface area allows penetration of organic and inorganic ions into the structure of sepiolite [1]. These properties make sepiolite to be candidate for removing cationic dyes, heavy metals, aromatic compounds and even pesticides in industrial field. Cryogels are three-dimensional megaporous hydrogel matrices, which are synthesized at a semi-frozen state in situ free radical polymerization by using an initiator/activator system, by photo or by electron-beam initiation [2]. The polymerization occurs in frozen water-soluble monomer/polymer solution, where cryo-gelation takes place in the interstitial spaces between the ice crystals. The ice crystals formed act as porogen and a polymer network of interconnected pores is formed after thawing. The brilliant characteristics of cryogels such as large pore sizes (up to 100 □m), short diffusion path, good biocompatibility, flexibility and high mechanical strength made them indispensable to the separation and purification processes [3-4]. They can be either used as pure polymeric, filled with solid micro/nano-particles or modified to obtain functional groups. In addition, cryogels are easy to prepare and cost-effective adsorbents, so they can be disposed off after use to avoid cross-contamination between successive batches of a sample.

In the present research study, a new sepiolite embedded nanocomposite cartridges were prepared for the removal of heavy metals from aqueous solutions. For this purpose, purified sepiolite was crashed and sieved in the size range of 60-250 □m and the sizes below 60 □m were used. Then, four different ratios of sepiolite embedded poly(hydroxyethyl methacrylate) (PHEMA) based nanocomposite cryogels were prepared in a cartridge form with a diameter of 8 mm. The surface morphology and porosity of sepiolite embedded nanocomposite cartridges were characterized by Fourier Transform Infrared (FTIR), scanning electron microscopy (SEM), computed micro-tomography (mCT), swelling studies, flow dynamics and surface area measurements. Binding experiments were carried out for the effect of initial concentration, pH and adsorption rate. In addition to, removal efficiency in a certified sample was also exemplified. Finally, sepiolite embedded nanocomposite cartridges were applied to water treatment system for the removal of heavy metals from aqueous solutions.

References

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