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Magnetic iron oxide alginate beads for removal of dye from aqueous solutions

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In the present study, a novel green and highly efficient magnetic adsorbent alginate beads were synthesized by instantaneous gelation of magnetic iron oxide nanoparticles (IoNPs) and sodium alginate (SAlg) mixture in calcium chloride solution. Magnetic iron oxide nanoparticles were prepared by co-precipitation method by using Gallnut extract as capping and stabilizing agent. The synthesized IoNPs were characterized by transmission electron microscopy and X-ray photoelectron spectroscopy. Highly porous magnetic IoNPs-SAlg beads were fully characterized with scanning electron microscopy, transmission electron microscopy, Fourier transform infrared spectroscopy, and X-ray diffraction. Elemental content of the IoNPs and IoNPs-SAlg beads was analyzed using energy dispersive spectroscopy. The magnetization properties were investigated by vibrating sample magnetometer technique. The synthesized IoNPs-SAlg beads were used as eco-friendly adsorbent for the adsorption of Congo red, Nile blue A, and Rose Bengal from water. Moreover, the maximum capacity of adsorption was compared with that of non-encapsulated IoNPs and SAlg beads. The results showed that addition of IoNPs in sodium alginate enhanced the adsorption capacity. The influence of important factors such as pH, temperature, adsorbent dosage, and initial dye concentration on adsorption capacity of magnetic IoNPs-SAlg beads was investigated. The maximum adsorption was found to be 92, 91, and 78 % for Congo red, Nile blue, and Rose Bengal, respectively. These results reveal that IoNPs-SAlg beads can be an eco-friendly, efficient, and low-cost adsorbent for the removal of dyes from water.

Keywords: Iron oxide nanoparticles, magnetic, alginate, beads, adsorption, dye.

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