TiO$_2$ immobilized PCL for photocatalytic removal of hexavalent chromium from water

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ABSTRACT

Photocatalytic remediation technologies employing titanium dioxide (TiO$_2$) particles have excellent applications due to the photoactive nature of this semiconductor. TiO$_2$ nanoparticle immobilization to polymer can be considered as alternative technique for the production of cheap materials for water remediation. The aim of this study is to produce an anatase type nano TiO$_2$ particles immobilized into or onto biodegradable polymer polycaprolactone (PCL), using simple solvent-cast processes. Produced materials were investigated and tested for photocatalytic reduction/removal of inorganic contaminant chromium(VI) ions from water. TiO$_2$ immobilized polymer successfully reduced/removed Cr(VI) ions (0.1–0.03 mM which is equal to 5–1.5 mg/L, respectively) from aqueous solution at pH 2 employing UV light (365 or 254 nm) source. Reduction of Cr(VI) ions to Cr(III) oxidation state was successful and the removal percentage was significantly high. TiO$_2$ immobilized into PCL (at 5% w/w) removed almost 40 ± 1% of Cr(VI) ions at 5 ppm initial concentration. Presence of citric acid as positive hole scavenger promoted the removal percentage and it reached to 96 ± 0.9% for 1.5 ppm initial concentration after 150 min exposure with 254 nm light source. Photocatalytic removal was still high as much as first run for the second and third cycles (95 ± 1.5 and 89 ± 2% removal after a 150 min illumination, respectively). These results indicate that TiO$_2$ immobilized material can be reused for several times after a simple remediation process. Furthermore, the material can be simply damped into soil and left for total biodegradation if it lost its photocatalytic properties.

Keywords: Biodegradable polymer; Polycaprolactone; Photocatalytic removal of chromium (VI)

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