

Hexavalent chromium removal using aerobic activated sludge batch systems added with powdered activated carbon

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Abstract

The addition of powdered activated carbon (PAC) has been proposed as a suitable technique to protect activated sludge against toxic wastewaters. However, the literature data describing the combined effect of PAC addition on Cr(VI) removal using activated sludge are scarce. The objectives of this study were to investigate the effect of the initial Cr(VI) concentration, PAC and an electron donor addition on Cr(VI) removal using aerobic activated sludge batch reactors.

The following Cr(VI) removal systems were tested: activated sludge alone; activated sludge with an external electron donor (5 g/l of lactose); activated sludge with PAC addition (4 g/l); activated sludge with both PAC and lactose; and PAC alone. The results reported here showed that activated sludges are capable of removing Cr(VI) via its reduction to Cr(III) only if a suitable electron donor (such as lactose) is available. For initial Cr(VI) concentration lower than 10 mg/l, biomass alone can remove 100% of the Cr(VI). However, for higher initial Cr(VI) concentrations, removal efficiencies (R_E) of the system with PAC were higher than R_E corresponding to the system without PAC. In addition, as the initial Cr(VI) concentration increased, the rate of Cr(VI) removal and R_E values decreased reflecting loss of metabolic activity of the activated sludge due to the toxicity of Cr(VI); however, this inhibition was less in systems with PAC. Whereas the removal of Cr(VI) using powdered activated carbon (PAC) alone is negligible, the addition of PAC can improve the biological reduction of Cr(VI) due to the stimulating or protective effect against the Cr(VI) toxicity. This protective effect was also observed in respiratory activity of the biomass.

Keywords: activated sludge, powdered activated carbon, hexavalent chromium, trivalent chromium