Micro and Nano Engineering for Wastewater: Toxic Cr(VI) Remediation Using Biochar and Nanoparticle from Wastewater

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Hexavalent Chromium (CrVI) is a priority pollutant, released by the tannery processes to the environment. The objective of this study was to assess the potential of novel materials magnetized biochar (MBC) and starch stabilized nano zero valent iron (NZVI) as novel composite to remediate Cr(VI) in tannery wastewater. Biochar, waste byproduct of dendro power plant, was magnetized by mixing aqueous biochar suspensions with aqueous Fe3+/Fe2+, followed by NaOH whereas NZVI was synthesized using borohydrate reduction at the inert environment. Batch experiments were conducted varying pH (3-9), time (2 to120 min), initial Cr(VI) concentrations (10 to 100 mg/L) and the presence of other ions such as Nitrate and Phosphate. Column study was conducted using the composite BC and nZVI (0.25% w/w each) at the flow rate of 1 mL/min. The available Cr(VI) was analyzed by UV Visible spectrophotometer. Electrical conductivity, pH, total Cr and Cr(VI) in tannery wastewater reported as 9 mS/m, 8.44, 28 mg/L & 0.5 mg/L respectively. The highest Cr(VI) removal was achieved at pH 3 for nZVI. The nZVI showed a fast removal by (67.3%) reaching its equilibrium within 20 min obeying pseudo-second-order kinetic model, suggesting chemisorption as the rate limiting process whereas for MBC it was rather slow and maximum removal was observed 21.0% at 4 h. The Langmuir maximum removal capacity for nZVI reached 154 mg/g. Removal of Cr(VI) was not significantly influenced by the presence of nitrate and phosphate however, it became low in the case of MBC. Column data revealed a removal of 45 mg/g of Cr(VI) using the composite of MBC-nZVI. Overall, these findings indicated that the composite could be utilized as an efficient and magnetically separable material for the removal of Cr(VI) in wastewater.

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