A Novel Approach for Wastewater Treatment Utilizing Adsorbent Enhanced Biosand Filtration

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Accelerated urbanization has increased wastewater through heavy metal contamination. This investigation aimed to deter contamination by implementing biosand filtration in conjunction with optimized concentrations of the novel bioadsorbent carboxymethyl cellulose (CMC) and industrially-used activated carbon (AC). Biosand filters were constructed using eco-friendly materials such as ionic exchange resin, infrared ceramic balls, and gravel. Three 0.1 M solutions of cobalt(II)chloride, iron(III)nitrate, and copper(II)sulfate were diluted and passed through four filters with varying concentrations of CMC and AC and three controls. Calibration curves were constructed ranging from 0.0012 M-0.0216 M and concentrations were determined through UV spectrometry/Beer-Lambert law. It was hypothesized that the 0.5 M CMC, 0.5 AC filter would be the optimum filter, and increasing the concentration of CMC would decrease metal ion concentration. The data indicated that the 0.5 M CMC, 0.5 M AC filter exhibited the highest filtration efficiency of 99.97% ± 0.0442% with copper(II) sulfate removed in the highest quantity. The biosand filters had percent removal ranging from 78.514±0.072%—94.703%±0.0353%, 69.79%±0.058%—99.96%±0.058%, and 56.13%±0.0464%—99.78%±0.044% of cobalt, iron, and copper ions respectively. The two-tailed t-tests performed indicate that the presence of CMC had a statistically significant impact on concentration with p-values ranging from <0.0001 to 0.00464. CMC had statistically significant removal compared to current industrial standards and traditional biosand filtration.