Comparative Analysis between Carboxymethyl Cellulose and Activated Carbon through Sedimentation and Ultrafiltration for the Removal of Metallic Ions from Industrial Wastewater

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Industrial wastewater engenders significant environmental concern primarily due to the environmental contamination caused by the presence of toxic heavy metals dissolved in water. This investigation addressed the issue by introducing carboxymethylcellulose (CMC), an inexpensive and abundant resource, as a more efficient filter than activated carbon. Using precipitation, a comparative analysis was conducted between both materials through an indirect measurement of the amount of metal ions. It was hypothesized that if CMC behaved as a complexing agent, hence retaining metal ions, then it would have a filtering efficiency above 80% and greater than that of activated carbon. Two types of filters were produced: for CMC a thin gel membrane subjected to a 650 mmHg vacuum was used to ultrafiltrate the 0.25 M aqueous solutions of $CuCl_2$, $Pb(NO_3)_2$, and $BaCl_2$, whilst for carbon, a gravity-assisted funnel was used. The results were successful, as CMC reacted with the metal ions in the solution forming a disposable waste. The average filtration percentages for Ba^{2+}, Cu^{2+}, and Pb^{2+} in the activated carbon filters were 48.79 % ± 3.72% , 88.66 % ± 1.29%, and 74.60 % ± 3.34%, respectively, while the average filtration percentage for Ba^{2+}, Cu^{2+}, and Pb^{2+} were 89.67% ± 1.42%, 95.04% ± 4.95%, and 86.87% ± 7.74%. On average, cellulose filtered 20 % more metal ions from solutions than carbon, supporting the hypothesis. In conclusion, this alternative method demonstrates to filter metallic ions from contaminated water more effectively, significantly impacting the environmental industry. In addition, CMC proved to be around 50 times more cost-effective than activated carbon.

Awards Won:

Third Award of $1,000