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POTENTIAL REMOVAL OF CHROMIUM (VI) IONS BY MACADAMIA NUTSHELL FROM STEEL INDUSTRY WASTEWATER

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Abstract

Steel industries generate wastewater laden with toxic metals such as Chromium VI(Cr^{6+}) which are classified as carcinogenic and toxic to aquatic life. There is need to meet standards for effluent discharge in order to comply with local and international standards. Chemical precipitation is a commonly applied low-cost technology, but has proven to be unsustainable due to sludge disposal that creates secondary pollution. Devki steel factory located in Ruiru municipality, Kiambu County is a factory that process steel products. Chemical precipitation is applied in Cr^{6+} treatment at effluent discharged at the factory which exceed international and local effluent discharge standard limits. There is thus need to develop innovative yet affordable technologies for Cr^{6+}. The potential of carbonized macadamia nutshell (CMN) in Cr^{6+} adsorption as an alternative and eco-friendly technology was evaluated. Carbonization process modified the adsorbent surface properties by increasing the surface area, pore size, carbon content, and Cr^{6+} removal rate from 40.21-380.64 m^2/g, 1.63-8.78 Å, 47.01-57.2% and 71-97% respectively. Maximum Cr^{6+} adsorption was obtained at a metal concentration 50mg/L, pH 4, contact time of 2 hours, 0.2g dose, and at 30°C. The equilibrium data were well depicted by Langmuir and Freundlich isotherm. Experimental data were well fitted with Pseudo second-order kinetics. Maximum adsorption capacity of 24.3 mg/g and removal efficiency at 97.2% was attained by CMN compared to raw macadamia nutshell (RMN) 17.95 mg/g and 71.6% respectively. The desorption results revealed that the spent adsorbent could be reused for three adsorption cycles, which makes the process eco-friendly.

Key words: adsorption, chemical precipitation, Cr^{6+}, desorption, macadamia nutshell

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