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Tea waste derived activated carbon-polyacrylamide composite as a potential agent for the removal of Chromium and Nickel from aquatic systems

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Water is one of the essential natural resources on Earth, therefore it is essential to protect water from pollution. The chemical contaminants represent the most dangerous types of contaminants found in the water for their persistence and toxicity even at minute concentrations. Chromium and Nickel are among the most toxic heavy metals that pollute water. Contamination of the water resources with these elements would affect the food webs and causes a threat to ecosystem functioning. Among the techniques in use for removing contaminants in water, adsorption is economical and technically feasible to administer. In this study, a new variety of activated carbon (AC) was produced through chemical activation of tea waste. Polyacrylamide-activated carbon composite (PAC) was successfully prepared through aqueous solution polymerization. Thereafter, its adsorption performance was tested for the removal of Chromium and Nickel ions from aqueous solutions and analysis was done using Atomic Absorption Spectroscopy (AAS). Optimization studies were carried out for the adsorbent dosage, treatment time, metal ion concentration, pH, and temperature in the medium. Further, adsorption kinetics, adsorption isotherm and adsorption thermodynamic studies were carried out for both the metal ions. The maximum adsorption of around 97 % by PAC for both Chromium and Nickel was observed when 5 mg/L initial concentration of adsorbate of the two metals was given 1 hour contact time at 25 °C temperature and pH 3, with 0.20 g adsorbent dosage. Further, Chromium adsorption process was fitted well with the Freundlich isotherm model and both Chromium and Nickel adsorption results followed pseudo-second order rate model. It was also observed that both adsorption processes were spontaneous under these conditions. It was concluded therefore, that polyacrylamide-activated carbon composite (PAC), made out of tea waste can be successfully used for the removal of Chromium and Nickel contaminants from aquatic systems.

Keywords: Polyacrylamide, Activated carbon, Adsorption, Chromium, Nickel