Abstract No: 05 ***Physical Sciences***

FLUORIDE REMOVAL EFFICACY OF ACTIVATED CARBON PREPARED BY ENVIRONMENTAL BENIGN CHEMICAL ACTIVATION METHOD

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This study investigated how well-activated carbon made from coconut coir can remove fluoride. Ferric chloride ($FeCl_3 \cdot 6H_2O$) was used as an activating agent. Coconut coir, an abundant and sustainable material in Sri Lanka, was first cleaned, dried, and impregnated with $FeCl_3 \cdot 6H_2O$ to enhance its adsorption properties. The impregnated coir was then carbonized at 250 °C for 1 hr to improve its porosity. After carbonization, excess $FeCl_3 \cdot 6H_2O$ was removed by immersing the activated carbon in 1.0 M HCl and heating it at 80 °C, followed by multiple washes with deionized water until the pH was neutral (pH 7). This process ensured that the activated carbon was free from residual chemicals that could affect its adsorption capacity. To evaluate the fluoride removal efficiency, batch adsorption experiments were conducted. In these experiments, 5 g of the prepared activated carbon was added to 100 mL of a 100 ppm fluoride solution, and the mixture was stirred at 400 rpm. Fluoride concentrations were monitored using a colorimetric method, where absorbance was measured with a UV-Vis spectrophotometer. A calibration curve was constructed to accurately quantify the fluoride concentration in the treated water samples. The adsorption kinetics showed that 75% fluoride ions were removed within the first 35 mins of the experiment, and equilibrium was achieved after 60 mins. The data were analysed using the Langmuir adsorption isotherm, which confirmed that fluoride was adsorbed onto the surface of the activated carbon in a monolayer fashion. The optimized conditions for effective fluoride removal included a carbonization temperature of 250 °C, a contact time of 60 mins, and a 5 g dose of activated carbon. The results demonstrated that coconut coir-derived activated carbon is a cost-effective and sustainable solution for removing high fluoride level than that of the value stipulated by the WHO from groundwater, offering a practical alternative to conventional methods such as reverse osmosis and ion exchange, particularly in resource-limited countries like Sri Lanka.

Keywords: Activated carbon, Carbonization, Coconut coir, Groundwater treatment