Optimisation and implementation of an ANN-based model for adsorption of ferrous ion from groundwater using banana stem-derived activated carbon

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The present study examines the potential of banana stem-derived activated carbon (ACBS) for removing ferrous ions from groundwater, supported by artificial neural network modelling. Batch experiments were conducted to evaluate adsorption performance. Kinetic studies indicated that adsorption followed Lagergren's pseudo-order and intra-particle diffusion mechanisms, while equilibrium data fitted best with the Langmuir isotherm, suggesting monolayer adsorption. Thermodynamic analysis demonstrated the process to be spontaneous and endothermic, with positive entropy change indicating enhanced disorder at the solid–solution interface. The artificial neural network (ANN) model effectively predicted adsorption behaviour, achieving a mean squared error of 0.00173 for ACBS, confirming its reliability.

Keywords: Activated carbon, adsorption, artificial neural network, banana stem, kinetics.

and household usage. Iron contamination can also leave stains on kitchenware, clothes, and plumbing fixtures[4]. The World Health Organization (WHO) stipulates a desirable ferrous ion concentration of 0.3 mg/L in drinking water, with a permissible upper limit of 1 mg/L[5]. In concentrations above 0.3 mg/L, ferrous ions can be detected by a bitter taste and yellowish colouration in water, leading to staining in material[6]. Precipitation[7], membrane technique[8], manganese greensand filter[9], ion exchange[10] and biological methods[11] are the various treatment techniques used by researchers in recent decades for Fe (II) removal from contaminated groundwater. Regular backwashing is necessary after precipitation to remove settled precipitates, and in the case of membrane techniques, high capital costs and regular semi-permeable membrane cleaning are associated[6,7]. Larger water treatment facilities should avoid employing manganese greensand filters due to their high maintenance expenses[8]. Because of ferrous ion precipitation, the ion exchange method is expensive for domestic use, loses exchange capacity in the presence of oxygen, and is ineffective for colloidal or complex ferrous ions[9]. Overall,