# TRIPARTITE MAGNETIC MONTMORILLONITE NANOCOMPOSITE FOR REMOVAL OF BISPHENOL A, NICKEL, CADMIUM AND LEAD IONS FROM INDUSTRIAL EFFLUENTS

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## ABSTRACT

The removal of Bisphenol A, Ni, Cd and Pb ions onto unmodified montmorillonite (MM), doped titanium nanocomposite (DTC) and tripartite magnetic montmorillonite nanocomposite (TMC) was investigated. The nanocomposites were prepared by in-situ reduction with iron salts followed by chemical impregnation by Sol-Gel method and subsequently coupled by chemical precipitation to form the TMC. Relevant spectroscopic methods were also employed for characterization. The modified clays showed magnetic properties with FTIR result, revealing new reflections at 1990 $cm^{-1}$ for –NCS (isocyanate). Similarly, the tripartite magnetic nanocomposite had new reflections at 1032 $cm^{-1}$ for cyanide (-OCN), 1625 $cm^{-1}$ for open chain azo (-N=N-), and 2050 $cm^{-1}$ for transition metal carbonyl (–M=CO-). XRD analysis revealed interlayer spacing (1.67-1.71 nm). BET surface area were respectively 90.39, 210.72 and 288.08 $m^2/g$ and adsorption capacities of 81.48, 82.27 and 91.05% for MM, DTC and TMC. The tripartite magnetic composite also had higher adsorption and photodegradation capacity (96.21%) towards the organic pollutant compared to unmodified clay (22.99%). Adsorption data were best fitted with Freundlich isotherm model revealing multilayer coverage as predominant mechanism of adsorption. Kinetic mechanism was predominantly pseudo-second-order, revealing chemisorption process. The thermodynamic studies confirmed that the process of adsorption was exothermic and spontaneous with negative standard enthalpy and Gibb's free energy (-58.21 kJ/mol) at 30°C. Similar trends were observed for metal ions adsorption. Modification imparted cationic and aromatic moiety onto the montmorillonite thus increasing pollutant-adsorbent interactions and enhanced adsorption of BPA and metal ions in a simulated industrial effluent. In a continuous plug flow column, the tripartite magnetic composite demonstrated longer breakthrough and exhaustion time (19, 45 hours respectively), compared to the conventional adsorbents (2, 21 and 5, 29 hours respectively) for BPA adsorption from simulated effluent. Similar trend was also observed for real effluent. Adams-Bohart isotherm showed highest adsorption capacity of 120.28 mg/g for simulated effluent and 29.60 mg/g for real effluent. In both real and simulated effluents, bed volume was highest with TMC and revealed that the prepared tripartite nanocomposite is an efficient alternative adsorbent and can compete with commercially available adsorbents.