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CHITOSAN/GRAPHENE OXIDE/SIO$_2$ NANOADSORBENTS FOR THE REMOVAL OF CR(VI) FROM WASTEWATERS

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Abstract – The swift industrialization and urbanisation have led to the discharge of significant amounts of hazardous heavy metals into water environments. Heavy metal pollution is currently one of the most significant environmental challenges being addressed, attracting researchers due to its biotoxicity and non-biodegradability even at minimal concentrations [1]. Chromium (Cr) is among the most prevalent heavy metal contaminants. Its oxidation state, Cr(VI), harms the environment yet has catastrophic consequences for human health [2]. It is removed by physical and chemical procedures such as ion exchange, chemical precipitation and electrochemical treatment. Yet, most of these procedures have downsides, such as the formation of hazardous sludge, causing disposal issues and the need for costly tools and monitoring systems [3] scanning electron microscopy and X-ray diffraction. Adsorption experiments were performed by varying pH, agitation speed, contact time, adsorbent dose and initial metal ion concentration. Freundlich, Langmuir and Temkin isotherms were used to analyze the equilibrium data obtained at different adsorption conditions. It was found that the adsorption isotherms were well fitted by the Freundlich equation and the adsorption process was found to follow pseudo-second-order rate kinetics. Adsorption results obtained show a maximum Cr(VI). Adsorption is regarded an appealing and favourable technology because of its ease of design, simplicity, and high efficiency. Carbon-based nanomaterials have been investigated as superior adsorbents in aqueous solutions for the separation of organic and inorganic contaminants. The current study recommends the usage of adsorbents based on graphene oxide (GO). GO is an oxygen-rich material that is produced during the oxidation of graphite. It features hydrophobic areas due to aromatic groups in the nanosheets' centres, along with a large number of hydrophilic functional groups such as hydroxy, aldehyde, epoxy, and carboxyl groups [4]. The latter allow GO to swell and perform electrostatic functions. Chitosan (Cs) is a great adsorbent since it is inexpensive, biocompatible, and causes no secondary pollution. Its molecular chains include -NH_2 and -OH groups, which can interact with heavy metal ions and give significant adsorption capacity [5] TiO2, and Fe3O4. The absorption equilibrium time of MCT was 40 min in absorbing vanadium (V). Silicon dioxide (SiO_2) nanoparticles with graphene oxide have better physical and chemical characteristics than graphene oxide-like surface area. Similar research has revealed that the presence of SiO_2 increases the adsorbent's adsorption capacity for Cr(VI) [6]. The effect of the pH value, contact time and initial chromium concentration was examined in order to determine the feasibility of Cs/GO@SiO_2. Its structure and the morphology were studied in detail by the application of BET, XRD, FTIR and SEM techniques. According to the results, the modification of Cs with GO@SiO_2 enhanced the percentage removal of chromium ions, especially, in acidic

conditions by using 0.5 g/L of the adsorbent. Experimental data of equilibrium were used to calculate adsorption isotherms. According to thermodynamics the spontaneous nature of their adsorption was confirmed. Overall, the results indicate that Cs/GO@SiO_2 can be effectively employed for removal of chromium from aqueous solutions.

Keywords – Adsorption; aqueous pollution; carbon-based materials; water treatment

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