

STUDY ON REUSABILITY OF MAGNETIC CHITOSAN WITH DIFFERENT MAGNETIZATION LEVEL FOR RADIONUCLIDE REMOVAL

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The increasing presence of heavy metals and persistent pollutants in aquatic environments poses a significant threat to ecological integrity and public health. Traditional water purification methods often involve high costs, substantial energy consumption, or the generation of secondary waste streams, highlighting the need for more sustainable solutions. Recent studies show that these limitations can be addressed by developing recyclable and magnetically separable sorbents, which reduce chemical usage and simplify post-treatment recovery, supporting more environmentally responsible water treatment strategies [1]. In eco-chemistry, natural polymer-based sorbents that are biodegradable and reusable have emerged as promising environmentally friendly options for water remediation. Magnetic chitosan composites combine the adsorption capacity of chitosan with magnetic separability, reducing secondary waste and operational complexity [2]. Incorporating magnetic components also enables repeated regeneration and reuse, enhancing process sustainability and economic feasibility compared with conventional non-recoverable sorbents [3]. This study evaluated the reusability and performance consistency of magnetic chitosan nanocomposite (MCN) as a green sorbent, focusing on its capacity and applicability over multiple treatment cycles in water purification systems.

MCNs were synthesized by embedding various ratios of Fe₃O₄ nanoparticles within a chitosan (100,000–300,000 m.v.) matrix using a crosslinking method. The prepared MCNs were characterized by XRD, TEM, FT-IR, Mössbauer spectroscopy, and magnetization measurements; zero-point charge (pH_{zpc}) and separation parameters were also determined. To assess reusability and potential changes in adsorption performance, multiple adsorption–desorption cycles were conducted using heavy metals (Cs(I) and Eu(III) ions) traced with radionuclides as adsorbates. The study confirms that reusable magnetic chitosan is a promising material for sustainable water treatment applications. Its biodegradability, low toxicity, and reusability are consistent with the principles of green chemistry, supporting the development of environmentally responsible technologies that reduce waste generation and resource consumption.

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