

Smart Nanomaterials Technology


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# Nanomaterials for Separation of Hazardous Contaminants from Wastewater

 Springer

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# Magnetic Nanocomposites and Their Applications in the Removal of Toxic Contaminants from Wastewater



Naseem Ahmad, Saimah Khan, Sanjana Yadav, Umme Salma, Nafish Fatima, Kashif Raees, Mohammad Shahadat, and Nafees Ahmad

**Abstract** The growing presence of water contaminants, such as organic pollutants and heavy metals, poses substantial environmental, and public health risks due to their toxicity and carcinogenic nature. Magnetic nanocomposites have emerged as effective materials for wastewater treatment, offering advantages like high surface area, magnetic responsiveness, and versatile functionalization capabilities. This chapter explores the synthesis techniques, such as co-precipitation, sol–gel, and green synthesis approaches, emphasizing their role in tailoring nanocomposites for enhanced performance and applications of magnetic nanocomposites in removing toxic contaminants from wastewater. Adsorption, photocatalytic degradation, and ion-exchange mechanisms are also highlighted in this chapter mentioning their effectiveness in removing toxic contaminants. Furthermore, it addresses the challenges associated with their practical application, including material stability, reusability, and potential environmental risks.

**Keywords** Magnetic nanocomposites · Heavy metals · Micropollutants · Adsorption · Advanced oxidation processes (AOPs)

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**Table 1** (continued)

Contaminant	Removal method	Advantages	Disadvantages
	Chlorination	Effective disinfection, low cost, widely used	Forms harmful disinfection byproducts (DBPs), ineffective against some pathogens
	UV irradiation	No chemical addition, effective against a wide range of pathogens	High energy consumption, no residual disinfection, limited by water turbidity

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