

Chapter 8

Industrial Waste Management Using Functionalized Magnetic Nanomaterials (FMNs)



Vasantha Thoti and Murali Mohan Achari Kamsali

Abstract Industrialization has led to a scarcity of pure and clean water, with contaminants such as metal particles, microbes, dyes, and non-biodegradable organics posing significant health hazards. To address this, sustainable methods to recycle waste and synthesize nanomaterials are being developed. Industrial pollutants, especially liquid pollutants like heavy metals and metalloids, disrupt local ecosystems and need to be removed from wastewater. Functionalized magnetic nanomaterial (FMNs) technology is an effective solution for water remediation, particularly for removing heavy metals. Recent trends focus on fabricating functionalized nanostructures to clean up contaminants. Methods for creating FMNs include using inorganic moieties, organic ligands, surface polymerization, and enzyme immobilization. These materials show promise in adsorbing pollutants and transforming them into safer forms. This chapter highlights the effectiveness of FMNs in eliminating pollutants, including heavy metals, toxic chemicals, and organic dyes. It also discusses wastewater treatment and management technologies in industries using FMNs. Overall, FMNs offer significant potential for environmental remediation, contributing to cleaner and safer water resources.

Keywords Functionalized magnetic nanomaterials (FMNs) · Industrial waste management · Hazardous chemicals · Heavy metals organic pollutants

8.1 Introduction

The provision of clean water has become a major concern due to industrial expansion and population growth. The build-up of harmful contaminants in surface waters is primarily attributed to the discharge of untreated wastewater from industrial, agricultural, factory, and domestic activities. These pollutants endanger aquatic ecosystems and human health, underscoring the necessity for effective treatment systems [1].

V. Thoti (✉) · M. M. A. Kamsali
Department of Chemistry, Sri Venkateswara College, University of Delhi, Delhi, India
e-mail: tvasantha@svc.ac.in