

Chapter 9

Role of Nanotechnology in Enhancing Waste Reclamation

Manjoo Rani


Shri Ram Murti Smarak College of Engineering and Technology, India

Saty Dev

 <https://orcid.org/0000-0002-0185-410X>


Shri Ram Murti Smarak College of Engineering and Technology, India

Sony Singh

 <https://orcid.org/0009-0004-3564-5025>

Shri Ram Murti Smarak College of Engineering and Technology, India

Arti Gupta

 <https://orcid.org/0000-0002-1831-4441>

Shri Ram Murti Smarak College of Engineering and Technology, India

Ravindra Kumar

Shri Ram Murti Smarak College of Engineering and Technology, India

ABSTRACT

The transformative role of nanotechnology offers ground-breaking solutions for waste reclamation and environmental safety. Fast urbanization and industrial growth are responsible for complexity and volume of the waste. Therefore, development of intelligent approaches for effective waste reclamation is needed. Nanotechnology has potentials to effective waste recycling through the alteration at molecular and atomic levels. The properties of nanomaterial such as reactivity, surface area, etc., formulate the advanced methods to reuse, reduce, treat and dispose the waste. This chapter emphasizes on the crucial role of nanotechnology in waste reclamation and its applications as the advanced waste treatment approach. The potentials of nanotechnology transformed the waste recycling/treatment processes, improved material recovery with environmental safety. Though, chapter also explains the environmental and health consequences of nanomaterials highlighting the requirement for sustainable practices and supervisory frameworks to confirm their safe use.

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INTRODUCTION

Abbreviations and Notations

Table 1.

nZVI	Zero-valent iron nanoparticles
e -waste	Electronic waste
PM	particulate matter
MOFs	Metal-organic frameworks
TiO ₂	titanium dioxide
VOCs	volatile organic compounds
MFC	Microbial Fuel Cells
CO	Carbonmonoxide
NO _x	Nitrogen Oxides
AgNPs	Silver Nanoparticles
ZnO	Zinc oxide nanoparticles
CuNPs	Copper Nanoparticles
NF	Nanofiltration
CDI	Capacitive Deionization
MOFs	metal-organic frameworks
FeO	iron oxide
JJM	Jal Jeevan Mission
AMRIT	Arsenic and Metal Removal by Indian Technology
MFCs	Microbial Fuel Cells

In the current scenario, the role of nanotechnology is enormously imperative, particularly when it contributes in waste reclamation. According to sustainable goal SDG 6 targets 2024, a population of 2.2 billion were without access to securely proficient drinking water and around 3.5 billion needed access to carefully managed hygiene. From 2002 to 2024 droughts and flood situations affected around 1.4 billion people. In 2022, coarsely 50% of the world's people faced severe water shortage all over the year, whereas one-fourth of the population faced tremendously high levels of water stress. Climate change deteriorates these matters, affecting important risks to social constancy. Coordinated global action on integrated water management, addressing the influences of climate change on water capitals, and better management of shared waters are key to reinstating focus on the objective. To overcome waste management problems in various fields, there is a global demand to introduce new technology for waste management. Nanotechnology provides inventive ways to turn waste into useful resources by changing materials at the nanoscale. Especially, to reduce pollutants extract valuable metals from electronic waste (e-waste) and on the other hand turn organic waste into renewable energy sources. To achieve this goal innovative nanomaterials and nanocatalysts were developed (Barwant and Satyannarayana, 2024). Therefore, minimizing pollution in the environment, is a multidimensional sustainable approach that promotes a

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