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CHAPTER 9

Earthworm-mediated Remediation and Mitigation of Heavy Metals Toxicity in Plants

Ashutosh Sharma[1], Pooja Sharma[2,3], Sahil Dhiman[1], Sandeep[1,4], Sanjay Kumar[5], Sukhwinder Kaur[5], Arun Dev Singh[3], Raj Bala[4], Renu Bhardwaj[3] and Indu Sharma[5,*]

[1] *Faculty of Agricultural Sciences, DAV University, Sarmastpur, Jalandhar, 144012, Punjab, India*

[2] *Department of Microbiology, DAV University, Sarmastpur, Jalandhar, 144012, Punjab, India*

[3] *Department of Botanical and Environmental Sciences, Guru Nanak Dev University, Amritsar, 143005, Punjab, India*

[4] *Department of Botany and Environment Studies, DAV University, Sarmastpur, Jalandhar, 144012, Punjab, India*

[5] *Department of Life Sciences, University Institute of Sciences, Sant Baba Bhag Singh University, Khiala, Jalandhar, 144030, Punjab, India*

Abstract: Earthworms are the ecosystem engineers that convert waste into vermicompost. The vermicompost is further utilized to improve the soil's organic composition, condition, and health. Recently, earthworms have been explored as an effective, efficient, and eco-friendly remediation approach called 'vermiremediation' to mitigate the toxic elements from the soil. The soil contains different types of essential or non-essential elements. The presence of these elements above threshold levels in the soil leads to its contamination. The major soil contaminants include xenobiotic compounds, agrochemicals, and heavy metals. The plants exposed to higher amounts of heavy metal-containing soils show symptoms of metal-induced phyto-toxicities that result from the loss of soil fertility, disturbance in nutrient uptake and translocation, and interruption in the regular physiological functions of affected plants. To overcome heavy metal-induced toxicities in plants and soils, the treatments of earthworms, either alone or in combination with PGPR or other soil amendments, are being tried. The present chapter is an attempt to compile information about phytoremediation and vermiremediation, distribution of earthworms in contaminated soils, remediation and amelioration of heavy metals by earthworms, and factors affecting bioaccumulation of heavy metals in earthworms.

Keywords: Bioaccumulation, Bioremediation, Phytoremediation, Phytotoxicity, Vermi-remediation.

* **Corresponding author Indu Sharma:** Department of Life Sciences, University Institute of Sciences, Sant Baba Bhag Singh University, Khiala, Jalandhar, Punjab, India-144030;
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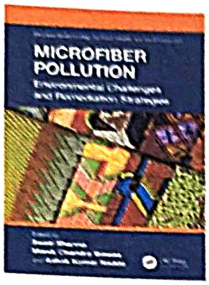

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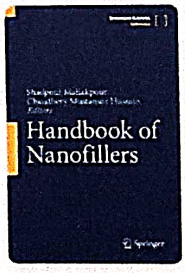

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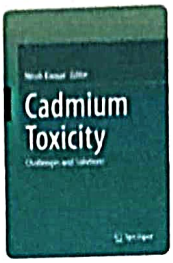

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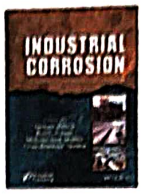

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First Published: 2024

ISBN: 978-81-966997-1-0

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Carbon Based Emerging Nanomaterials for Hydrogen Storage

Vivek*[1,2], Sumit Kumar[2] and Munish Sharma*[3]

[1]Department of Physics, Himachal Pradesh University, Shimla, HP-171005, India.
[2]Department of Physics, Govt. College Una, Una, H.P.-174303, India.
[3]Department of Physics, School of Basic and Applied Sciences,
Maharaja Agrasen University, Baddi, H. P.-174103, India.
*Author's Email: Vivek: vivekhpu@gmail.com,
Munish Sharma: munishsharmahpu@live.com

Abstract

As the population grows, the world's energy demand continues to increase. Existing energy sources such as fossil fuels are harmful to the environment and are being used up every day. There is now a need to find sustainable fuels that can meet the needs of modern people. Hydrogen is a promising alternative to conventional fuels due to its high energy content, zero greenhouse gas emissions and low environmental impact. However, hydrogen storage involve some difficulty to seek out material with huge hydrogen gravimetric density (HGD) suggested by the U.S. Department of Energy. Nanotechnology plays an important role to find out materialswith efficient hydrogen storage. Carbon-based nanomaterials can be promising hydrogen storage materials due to their chemical stabilities and high surface area. This chapter describes different areas of sustainable hydrogen storage that utilize the services of nanotechnology. Through a comprehensive analysis, we highlight the opportunities and challenges associated with utilizing carbon-based nanomaterials for hydrogen storage and discuss their potential implications for the future of clean energy technologies.

1. Introduction

Energy stands as a crucial catalyst for the economic advancement of any nation. On one hand, global demands surge due to population growth and evolving lifestyles, while on the other, natural reservoirs

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Culture, Identity and Storytelling in a Changing World

Editors

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ISBN: 978-93-5879-952-1
ISBN-10: 93-5879-952-8
DIP: 18.10.9358799528
DOI: 10.25215/9358799528
Price: ₹ 900
Editon: May, 2025 (First Edition)

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PREFACE

This edited volume is the outcome of an extended intellectual engagement that initially found momentum around an international

Chapter 19

Chemistry of Science Fiction in Literature, Art and Culture

Ravinder Dogra [1], Gian Chand [2], Samjeet Singh Thakur [3]

Abstract

This article explores how scientific ideas—particularly those rooted in chemistry—inspire and shape the narratives of science fiction across literature, art and popular culture. Chemistry, as a transformative and foundational science, plays a central role in fictional explorations of dystopian futures, alchemical experimentation, synthetic life and pharmaceutical innovation. Through such depictions, science fiction engages deeply with questions of ethics, identity and the boundaries of human control over nature.

From Mary Shelley's *Frankenstein* where chemical experimentation provokes existential dilemmas, to contemporary films and television shows that dramatize the consequences of chemical innovations—from consciousness-altering substances to bioweapons—chemistry becomes a symbolic medium through which societal hopes and fears about scientific progress are imagined and interrogated. Visual arts, too, reflect this ambivalence, often using chemical motifs to explore themes of creation, decay and the unknown.

By tracing representations of chemistry across speculative genres and media, this study highlights how science fiction mediates public engagement with scientific ideas. It not only entertains but also fosters critical reflection on the promises and perils of technological advancement. The paper argues that science fiction acts as a cultural bridge, connecting scientific inquiry with ethical discourse and

[1] Assistant Professor, Chemistry, Govt. College Una, Himachal Pradesh

[2] Assistant Professor, English, TS Negi Govt. College Rekongpeo, Himachal Pradesh

[3] Assistant Professor, Chemistry, NSCBM Govt. College Hamirpur, Himachal Pradesh

*Corresponding Author Email: samar23chem@gmail.com