Chapter 6
Chemical and Biological Processes for E-Waste Recycling

P. Selvakumar
https://orcid.org/0000-0002-3650-4548
Department of Science and Humanities, Nehru Institute of Technology, India

Ritu Dahiya
https://orcid.org/0000-0001-5788-006X
Chhotu Ram Arya College, India

T. C. Manjunath
https://orcid.org/0000-0003-2545-9160
Rajarajeswari College of Engineering, India

Santosh Kumar Nathsharma
https://orcid.org/0000-0003-3935-2938
Stewart Science College, India

ABSTRACT

The proliferation of technology-driven consumption coupled with shortened product lifecycles contributes significantly to the escalating volumes of e-waste generated worldwide. As societies become increasingly dependent on electronic gadgets for communication, entertainment, and daily tasks, the disposal and recycling of these devices pose critical environmental and health challenges. However, within these challenges lie opportunities for innovation, sustainable practices, and economic growth through the establishment of effective e-waste recycling systems. Furthermore, the complexity of electronic devices, characterized by a wide variety of materials and components, complicates the recycling process. Moreover, the lack of standardized

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INTRODUCTION

The proliferation of technology-driven consumption coupled with shortened product lifecycles contributes significantly to the escalating volumes of e-waste generated worldwide. As societies become increasingly dependent on electronic gadgets for communication, entertainment, and daily tasks, the disposal and recycling of these devices pose critical environmental and health challenges. However, within these challenges lie opportunities for innovation, sustainable practices, and economic growth through the establishment of effective e-waste recycling systems

Furthermore, the complexity of electronic devices, characterized by a wide variety of materials and components, complicates the recycling process. Effective separation, recovery, and recycling. Moreover, the lack of standardized e-waste collection systems and regulations in many regions contributes to informal recycling practices, often carried out under unsafe conditions by informal workers in developing countries. Despite these challenges, e-waste recycling presents significant opportunities for sustainable development and economic benefits. Recycling e-waste not only conserves natural resources by extracting valuable materials thereby closing the loop in the product lifecycle and promoting a circular economy. Additionally, the recycling industry has the potential to create jobs, particularly in areas where formal e-waste recycling infrastructure is established and supported. These regulatory measures aim to improve e-waste collection rates, enhance recycling efficiency, and minimize the environmental footprint of electronic devices throughout their lifecycle.

Technological advancements in e-waste recycling are also driving innovation in the field. Processes such as mechanical shredding, magnetic separation, and hydrometallurgical techniques are being developed and refined to recover valuable metals and materials from electronic waste efficiently. Moreover, research and development efforts focus on improving the scalability and cost-effectiveness of recycling technologies to meet the growing demand for sustainable waste management solutions. Collaboration between governments, industry stakeholders, academia, plays a crucial role in advancing e-waste recycling practices globally. Partnerships facilitate knowledge sharing, development of best practices for responsible e-waste management. Initiatives to raise awareness among consumers of also contribute to shaping a culture of sustainability and environmental stewardship. Looking ahead, addressing the challenges and seizing the opportunities presented by e-waste re-

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