Chapter 7

A Comprehensive Review of Precious Metals Recovery From Electronic Waste

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ABSTRACT

The growing demand for electronic devices and shorter product lifecycles has led to a surge in electronic waste, especially waste printed circuit boards, rich in valuable metals like gold, silver, and platinum, often in higher concentrations than natural ores. Traditional pyrometallurgical recovery processes are energy-intensive and environmentally damaging, driving a shift toward more sustainable approaches. Hydrometallurgical methods, such as leaching and solvent extraction, offer reduced energy requirements and enhanced selectivity. Recent advancements are exploring eco-friendly leaching agents to improve precious metal recovery, though challenges

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with reagent stability and environmental impact remain. Cutting-edge techniques like ionic liquid application show high extraction efficiencies, while alternative methods, such as bioleaching and biosorption, are gaining traction due to their low environmental impact. This chapter examines key techniques for precious metal recovery, emphasizing the need for continued research to optimize sustainable and cost-effective processes.

1. INTRODUCTION

The surge in technological advancements, population growth, and economic expansion has increased the acquisition of electrical and electronic equipment (EEE). Unfortunately, the lifespan of these devices has shortened, driven by marketing, consumerism, and social media influences that emphasize the latest models as essential for happiness.

This trend has resulted in a significant rise in electronic waste (e-waste), with global generation reaching approximately 49 million metric tons in 2019 and projected to rise to 74.7 million metric tons by 2030 (Forti et al., 2020).

In parallel with this growing volume, there is increasing concern about the environmental and economic consequences of inadequate waste management.

Alarmingly, only about 17.4% of e-waste is currently being recycled, while the remaining 82.6% end up in landfills, promoting soil and water contamination due to hazardous materials such as heavy metals, plastics, and resins found in these devices (Butturi et al., 2020; Ruiz, 2023).

In addition to environmental risks, the inadequate recovery of valuable materials represents a significant loss of economic potential, particularly for critical and precious metals.

This scenario highlights the need for strategies that not only mitigate ecological impacts but also enhance resource circularity and economic efficiency.

1.1. Environmental, Health Risks and Economic Value of E-Waste

Due to the challenges of safe disposal, e-waste presents a significant risk to public health and the environment. Its complex composition includes several hazardous chemicals, making proper waste management both difficult and costly (Butturi et al., 2020).

This complexity often results in insufficient recycling efforts and reliance on landfill disposal, which exacerbates environmental degradation and public health risks (Forti et al., 2020).

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