

## Recovery of Metals from Electronic Waste by Physical and Chemical Recycling Processes

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**Abstract :** The main purpose of this article is to provide a comprehensive review of various physical and chemical processes for electronic waste (e-waste) recycling, their advantages and shortfalls towards achieving a cleaner process of waste utilization, with especial attention towards extraction of metallic values. Current status and future perspectives of waste printed circuit boards (PCBs) recycling are described. E-waste characterization, dismantling/ disassembly methods, liberation and classification processes, composition determination techniques are covered. Manual selective dismantling and metal-nonmetal liberation at - 150  $\mu\text{m}$  at two step crushing are found to be the best. After size reduction, mainly physical separation/concentration processes employing gravity, electrostatic, magnetic separators, froth floatation etc., which are commonly used in mineral processing, have been critically reviewed here for separation of metals and non-metals, along with useful utilizations of the non-metallic materials. The recovery of metals from e-waste material after physical separation through pyrometallurgical, hydrometallurgical or biohydrometallurgical routes is also discussed along with purification and refining and some suitable flowsheets are also given. It seems that hydrometallurgical route will be a key player in the base and precious metals recoveries from e-waste. E-waste recycling will be a very important sector in the near future from economic and environmental perspectives.

**Keywords :** e-waste, WEEE, recycling, metal recovery, hydrometallurgy, pirometallurgy, biometallurgy

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