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A comparative review on recovery of heavy metals from printed circuit boards (PCB'S) by chemical and bio-leaching

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The electronics industry is the world's largest and fastest growing industry. This consumer-centric industry's combination of technology advancements and quick product obsolescence creates new environmental issues. There is an urgent need to address the volume and toxicity of electronic waste generated. Printed circuit boards (PCBs) are a significant component of electronic trash, containing mostly heavy metals such as copper (Cu), tin (Sn), zinc (Zn), and lead (Pb). Metal recovery and recycling from PCBs is an important step in pollution prevention. Researchers have devised many methods for recovering precious metals from PCBs, including gravity separation, magnetic separation, and electrostatic separation, as well as PCB separation using the organic solvent technique, leaching method, bioleaching method, or a combination of these methods. This research provides a brief summary of India's present e-waste status, environmental and health risks, continuing waste disposal and recycling activities, and emphasizes the recovery of heavy metals from PCBs by systematic leaching/bioleaching.

Keywords: Printed Circuit Board (PCBs), Metal extraction, Chemical Leaching, Biological leaching, Adsorption.

Introduction About Pcbs-Environmental Problem

The discarded Printed circuit boards (PCBs) include a large number of heavy metals as well as non-metallic components. PCB scrap consists primarily of ferrous components (50%), plastics (21%), non-ferrous metals (13%), and miscellaneous substances (16%). Copper, tin, lead, mercury, cadmium, arsenic, nickel, and hexavalent chromium are found in excess of permitted levels [1]. PCBs may be removed from a variety of electronic devices, including television boards, CD players, and mobile phones, among others. According to researchers, the average rate of PCB manufacturing has increased by 8.7% each year, resulting in rising environmental concerns that need to be addressed in (Table 1) [2]. The typical metallic compositions of several PCBs are shown in (Fig. 1) [3]. Furthermore, ecologically friendly polymers and ceramic elements such as SiO_2, Al_2O_3, polyethylene, polypropylene, PVC, and Nylon are present in electronic trash [4]. It is critical to evaluate alternative ways for dealing with these hazardous chemicals. A research [5] examined and proved that particle size reduction during milling operations boosted copper release to 100%. The metal concentrations were determined using hydro-metrological techniques, which yielded precious metal values of Ag 0.238 g kg^{-1}, Au 0.725 g kg^{-1}, Cu 6.5 g kg^{-1}, and Ni 16.38 g kg^{-1} [6]. In a separate case, study on the composition of desktop PCs revealed an average weight of 60lb of various metals. Switzerland generates 66,042 TPA of E-waste per year, Germany generates 1,100,000 TPA, the United Kingdom generates 915,000 TPA, the United States generates 2,124,400 TPA, Thailand, Denmark generates 118,000 TPA, Canada generates 67,000 TPA, and India generates 146,111 TPA [7]. Several investigations were also done on a variety of samples in various concentration ranges. In Japan in 2007, several different E-waste collecting facilities separated a sample of 20 personal computers (PCs). The chemical element analysis reveals metal concentrations ranging from 13.8% to 24.6%, Fe 0.2% to 4.79%, and Au 0.0076% to 0.02%, respectively [8].

E-waste is a huge rising concern throughout the world, with technological obsolescence accounting for around 80-90% of this trash. Several techniques of characterisation and therapy are described in the literature [9]. Metal recovery was proven in the bioreactor followed by precipitation, and variations in treatment

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