

Urban Mining of e-scrap – Biohydrometallurgy is the future

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Voluminous generation of electronic waste (e-waste) is a global trend, with 53.6 Mt of generation in 2019; it is further expected to reach 74.9 Mt by 2030 world-wide. This waste is a secondary source of various valuable metals including critical and rare metals, and processes of recovering these metals has been seen with the concept of urban mining. While pyrometallurgical and hydrometallurgical methods are most commonly utilized, but these are coupled with energy intensiveness and the generation of hazardous wastewater, respectively. Biohydrometallurgy is an emerging technique that has the potential to mitigate these limitations by utilizing microorganisms. For the past twelve years, our research group has been using cyanogenic bacterial strains including *Chromobacterium violaceum*, *Pseudomonas fluorescens*, *Pseudomonas balearica*, and *Bacillus sporothermodurans* for the recovery of various metals from Waste Computer Printed Circuit Boards (WCPBs). The WCPBs are a cause of great environmental concern, accounting for nearly 3-6% wt. of total electronic waste. Thus, we are harnessing the metabolic activities of microorganisms to facilitate the extraction, and transformation of metals from WCPBs. To overcome the specificity limitations of this green technology, we devised sequential leaching approach through chemo-biohydrometallurgy process. Pretreatment with Ferric chloride led to the maximum recovery of Cu metal prior to biocyanidation process. Consequently, the leaching efficiency for other valuable metals such as Ag, Au, and Pt improved to 57%, 67% and 60%, respectively by novel *Bacillus* strain (i.e., *Bacillus sporothermodurans*). We reported this new *Bacillus* strain as potential bacteria with toxicity tolerance to $EC_{50} = 450 \text{ g L}^{-1}$ of pulp density (crushed WCPBs with particle size $< 150 \mu\text{m}$). Thus utilizing these promising microbial strains, biohydrometallurgical processes can be implemented on a large-scale to achieve the agenda of the Sustainable Development Goals under the strategies of urban mining.

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