

Experimental Recovery of Gold, Silver and Palladium from Electronic Wastes Using Ionic Liquids BmimHSO₄ and BmimCl as Solvents

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Abstract : One of the major challenges of sustainable development is promoting an industry which is both ecologically durable and economically viable. This requires processes that are material and energy efficient whilst also being able to limit the production of waste and toxic effluents through effective methods of process synthesis and intensification. In South Africa and globally, both miniaturisation and technological advances have substantially increased the amount of electronic wastes (e-waste) generated annually. Vast amounts of e-waste are being generated yearly with only a minute quantity being recycled officially. The passion for electronic devices cannot ignore the scarcity and cost of mining the noble metal resources which contribute significantly to the efficiency of most electronic devices. It has hence become imperative especially in an African context that sustainable strategies which are environmentally friendly be developed for recycling of the noble metals from e-waste. This paper investigates the recovery of gold, silver and palladium from electronic wastes, which consists of a vast array of metals, using ionic liquids which have the potential of reducing the gaseous and aqueous emissions associated with existing hydrometallurgical and pyrometallurgical technologies while also maintaining the economy of the overall recycling scheme through solvent recovery. The ionic liquids 1-butyl-3-methyl imidazolium hydrogen sulphate (BmimHSO₄) which behaves like a protic acid and was used in the present research for the selective leaching of gold and silver from e-waste. Different concentrations of the aqueous ionic liquid were used in the experiments ranging from 10% to 50%. Thiourea was used as the complexing agent in the investigation with Fe³⁺ as the oxidant. The pH of the reaction was maintained in the range of 0.8 to 1.5. The preliminary investigations conducted were successful in the leaching of silver and palladium at room temperature with optimum results being at 48hrs. The leaching results could not be explained because of the leaching of palladium with the absence of gold. Hence a conclusion could not be drawn and there was the need for further experiments to be run. The leaching of palladium was carried out with hydrogen peroxide as oxidant and 1-butyl-3-methyl imidazolium chloride (BmimCl) as the solvent. The experiments at carried out at a temperature of 60 degrees celsius and a very low pH. The chloride ion was used to complex with palladium metal. From the preliminary results, it could be concluded that pretreatment of the treatment e-waste was necessary to improve the efficiency of the metal recovery process. A conclusion could not be drawn for the leaching experiments.

Keywords : BmimCl, BmimHSO₄, gold, palladium, silver

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