Technology Summary: Metal Extraction from Electronic Waste

Opportunity Statement

Large volumes of electronic goods, such as computers, mobile phones, music players, televisions and cameras, are being disposed every day. These devices contain various metals such as lead (Pb), copper (Cu), gold (Au), aluminum (Al), silver (Ag), palladium (Pd) and ferrous metals, which are often disposed as waste (known as electronic waste or E-waste). These metals are usually extracted by manually sorting and grinding the materials and then separating the metals in smelters. The facilities used for this process are often unsafe, exposing the workers and the environment to toxic gases and metals.

E-waste disposal is a prevailing problem in developed countries. Technologies for the recovery of valuable materials from E-waste have been developed to resolve this problem. Current technologies can be broadly categorized as thermal processing, bioleaching and hydrometallurgical processing.

There are both regulatory and economic drivers behind the use of these technologies. Developed countries, such as those in the European Union, have passed laws and regulations mandating original equipment manufacturers to collect E-waste from private users and dispose of it in an eco-friendly manner. Developing countries are also taking action. For example, in 2009 the Chinese government revised and supplemented a "List of banned imported solid wastes" to include various categories of E-waste. In addition, with the price of metals such as Cu realizing substantial increases over the past year, the economic advantages of recovering these commodities have correspondingly increased.

Problem

Each of the technologies listed above have decided disadvantages which minimize their utility. For example, thermal processes, such as pyrometallurgical technologies, cannot deal with certain metals (e.g., Al) and can only process E-waste with high metal content. This technology also produces dioxins and is both capital- and energy-intensive.

Therefore, there is a need for a solution which addresses the limitations of current technologies and provides a cost-effective, efficient, safe and eco-friendly answer to this growing problem.

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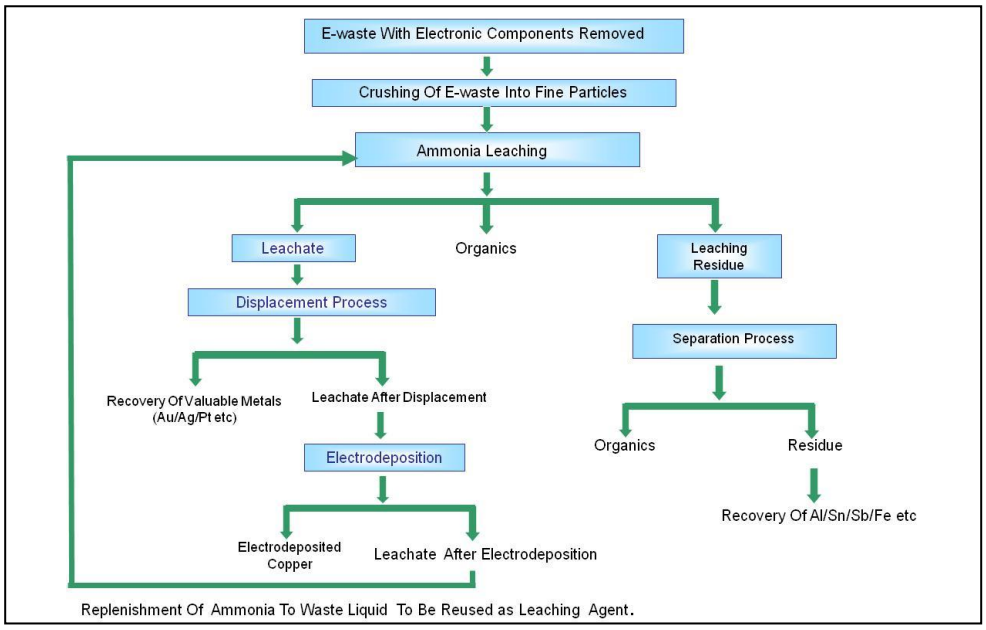
360ip's Partner Solution

The technology developed by 360ip's partner provides an integrated approach as shown below.



The process includes the following steps:

1. Crushing – The E-waste components are crushed to yield particles of less than 5 mm in diameter.

2. Selective ammonia leaching – This selective ammonia leachate is comprised of ammonia salt and ammonia, where the concentration of the NH_4^+ ion is 2–8 mol/L and the concentration of NH_3 is 1–5 mol/L. The crushed waste is added to the system. An oxidant such as sodium chlorate, sodium hypochlorite, bleaching powder, chlorine gas or oxygen is added to the ammonium leachate, at which time the metals and ammonia react to form $Me(NH_3)^+$ ions; where Me is Au, Ag, Pd, Cu, and Pb, as well as zinc (Zn), nickel (Ni), cobalt (Co) and cadmium (Cd).

3. Separation of organic substances – After leaching, the organic substances float on the surface and the heavier metal particles, such as Au, Ag, Pd, Cu, Ni, Co, Cd, Zn and Pb, enter the solution.

4. Displacement – The metal ions in the solution are displaced by adding sponge Cu powder to the leachate. The Cu displaces those metal ions with lower activities.

5. Electrochemical Deposition – Cu in the leachate is recovered by electrochemical deposition using a cathode and anode of appropriate materials. The electrolytic solution that still contains metals is recycled back to the leaching stage. These metals are extracted when their concentrations exceed 5 g/L.

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The key advantages associated with this technology are as follows:

- Less capital- and energy–intensive solution
  - ✓ Initial investment is almost 30% less than pyrometallurgical technologies
- Reduces emission of harmful gases when compared to conventional technologies
- Enables reuse of waste liquid
- Able to handle a wide variety of waste materials with high metal recovery rate

Patents

360ip's partner has filed one patent application on this invention.

Summary

360ip's partner has developed a solution that possesses substantial advantages over conventional technologies in the growing field of metal recovery from E-waste.

360ip is seeking interested parties for the further development and commercialization of this technology-based solution.

For additional information, contact:
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