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Printed circuit board leach residue as a reductant for pyrometallurgical operation

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In recent years, there has been an increase in the generation of Waste electrical and electronic equipment (WEEE) due to the advancement of technology. Printed circuit board (PCB) is the main focus of electronic waste because of the inherently high value of contained metals such as copper and gold. Hydrometallurgical processes, consisting of several leaching stages, are the most feasible option for the recovery of metals from PCB waste. However, hydrometallurgy does not address the issue of non-metallic PCB fractions that may end up being dumped at land fill sites or incinerated. When the non-metallic fractions are dumped, the heavy metals and the brominated flame retardants leach into groundwater leading to secondary pollution. Several options for treatment of the non-metallic fraction including material recycling, where the residue may be used as inclusions in concrete or asphalt materials with minimal processing or chemical recycling, where chemicals and fuels are produced from the residue using techniques such as pyrolysis exist.

Due to the complex composition of PCB leach residue, recovery by thermal treatment is likely to be the most feasible process route from technical and economical perspectives. In this study, the utilisation of the non-metallic leached PCB waste fraction as reductant in primary metal smelting operations and solid state pre-reduction is investigated. Analysis of the leached residue revealed that PCB is highly amorphous and has a carbon content of 28.5%, oxygen content of 23.1%, with the ash and volatile matter contents being 40.1% and 44.8% respectively.

Thermodynamic modelling and laboratory-scale experiments that simulate chromite smelting and solid state pre-reduction operations were performed using various blends of PCB and carbonaceous reducing agents. The models showed that PCB residue might be used to partially replace the conventional reductants. Preliminary investigations revealed that in chromite smelting the optimal blend contains up to 20 wt% PCB residue, with energy savings of 200 kWh/t of ore to achieve the same metal recovery.

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