The benefits of pre-treating PCBs with DMSO for a high copper recovery by leaching with H_2SO_4

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One of the problems associated with the recovery of metals from printed circuit boards (PCBs) is related with the presence of an epoxy resin layer coating some metals such as copper [1]. Even though mechanical processes such as grinding the epoxy resin is partially destroyed, the access to the inner layers of copper is a difficult task. The epoxy resin is often combined with flame-retardants to protect PCB from burning, making it extremely stable at high temperatures. A previous study has shown that the use of DMSO as epoxy solvent proved to be an effective method to weaken the PCB, despite the reaction mechanism between the epoxy and DMSO is not known [2]. In an industrial approach the use of a solvent as pretreatment can provide benefits such as the reduction of leachant consumption and impurities dissolved, a decrease in extraction time and the achievement of high recovery rates. DMSO does not present a major hazard to the operator and the environment may be used with safety at its boiling temperature (in neutral or alkaline conditions) and able to be recovered by distillation for later use.

Experimental – 5 g of PCBs with a size of 16 mm² were treated with 35 mL of DMSO at 183 °C for 60 min. The solid residue was placed to react with 50 mL of H_2SO_4 1.5 mol/L and 20 mL of H_2O_2 50% (v/v) for 180 min at 30 °C and in orbital agitation of 200 rpm. Leachate samples of 1 mL were collected at 30, 60, 120 and 180 min, for further analyses in atomic absorption.

Results and Discussion – The use of DMSO as solvent proved to be effective in destroying not only the epoxy resin but also causing damage to the PCB structure. As can be seen in Image 1, after treatment with DMSO the PCBs swelled and flaked, exposing the metal fraction under epoxy coating to H_2SO_2 and H_2O_2 effect. As can be seen in Image 2 the treatment with DMSO benefited

the further leaching not only reducing the extraction time but also achieving a higher copper recovery (95 % of copper



Image 1. PCBs after DMSO treatment at 183 °C.

present in the sample was extracted at 30 min and 99 % at 180 min) if compared without DMSO treatment (64 % of copper present in the sample was extracted at 30 min and 71 % at 180 min). Further study is necessary to ensure DMSO extracted no metal.

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Conclusions – Higher copper extraction rates were achieved when a pre-treatment with DMSO was applied to PCBs (99% at 180 min compare with 71 % at same time). Grinding combined with DMSO pre-treatment it might be an alternative solution to the excessive reduction of particles required for high recovery rates preventing the formation of dust and possible loss of valuable materials.

References

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