

Liberation study of waste printed circuit boards for recycling base and precious group metals

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INTRODUCTION

- Waste Printed Circuit Boards (WPCBs) encompass about 3% of the 50Mt/year of global e-waste generation
- WPCB is typically copper-clad laminate; key component of electronic equipment since it provides electrical connection of and mechanical support for others
- Contain many metallic components including base and precious group metals with a concentration higher than those of primary resources, making them economically attractive for recycling
- Process
 - Pre-treatment
 - Liberation**
 - Physical separation
 - Chemical separation
 - Purification

LIBERATION CHALLENGES AND OBJECTIVES

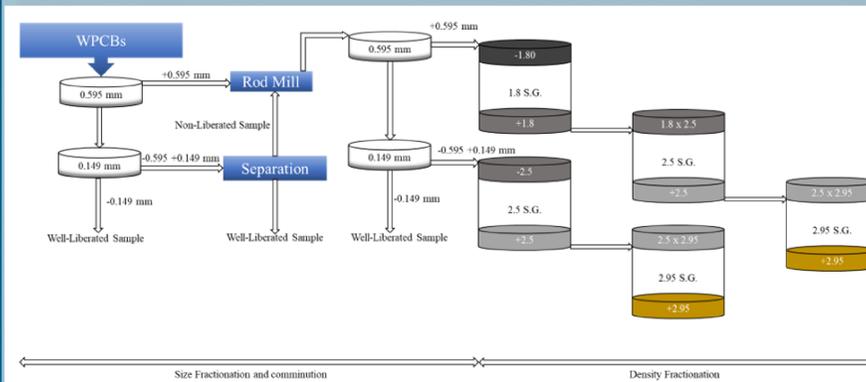
- PCBs contain glass fibers, reinforced resin, and copper wires; conventional crushing methods are less effective
- Increase in temperature can further bunch plastics and metals, while causing devolatilization of resin
- Fine particles and dust are produced due to uncontrolled grinding; additional measures necessary to minimize loss
- Different sized elements; no universal optimal size fraction
- Objectives
 - Ensuring disassociation between the target metals and non-metals (**presentation focus on Cu and Au**)
 - Effective liberation eases the later physical and chemical separation
 - Lower the amounts of metals in the tailing

Microscope view of -25.4+12.7mm then -12.7+4.76mm size



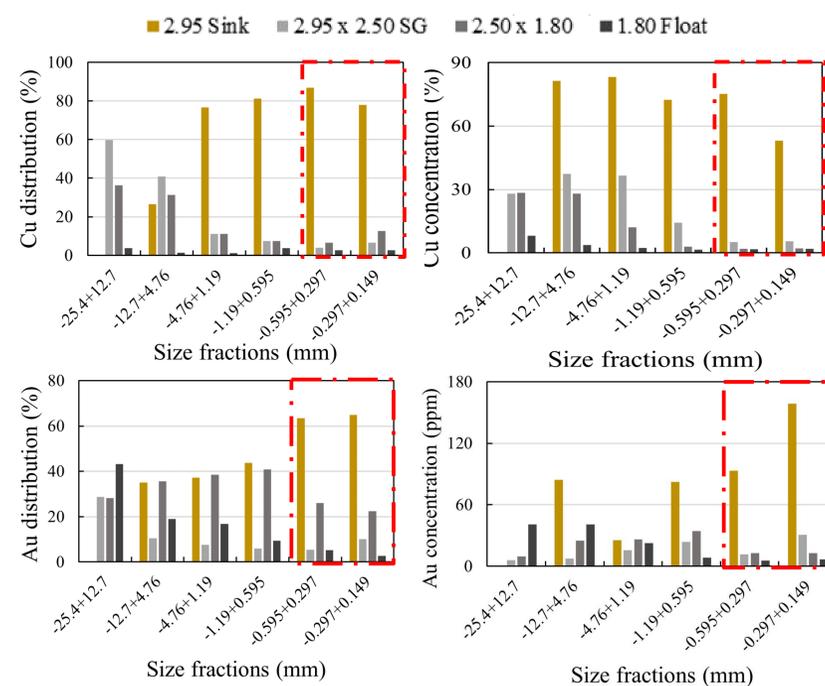
MATERIALS AND METHODS

- Pre-treatment (disassembly, cutting, and thermolyzer process)
- Liberation (sized density fractionation and comminution)



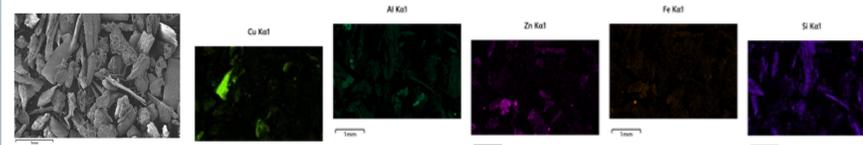
RESULTS AND DISCUSSION

Characterization of size-by-size density fractions

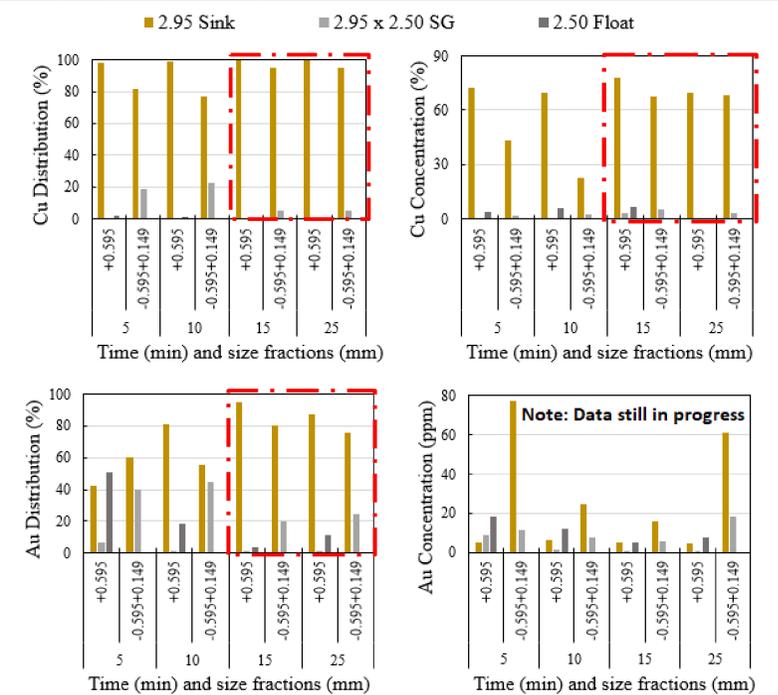


- +0.595mm: Not liberated** – requires size reduction
- 0.595mm+0.149mm: Moderately liberated
- <0.149mm: Well liberated

SEM-EDS Image and element distribution (-0.595+0.297mm)



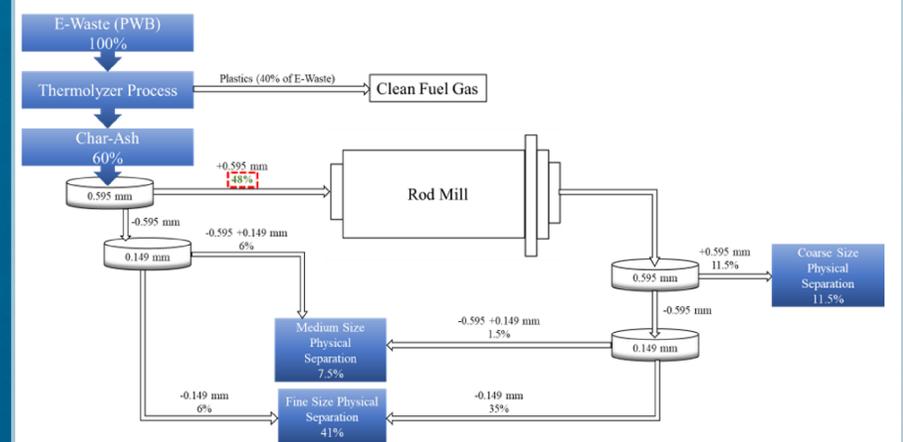
Grinding optimization



- Optimum grinding condition: 2 kg/hr

CONCLUSIONS

- Reduced feed to and energy use of the grinding circuit by 52%



ACKNOWLEDGEMENTS

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