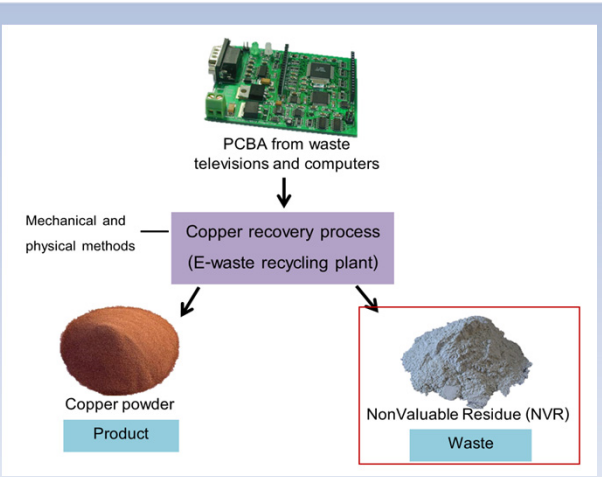
# Solidification/Stabilization of Nonvaluable Residue from Waste Printed Circuit Board Assembly

## Introduction: Nonvaluable residue from waste printed circuit board assembly (PCBA)

- The process of copper recovery from waste PCBA has remained a large fraction of solid waste residue.
- In this study, so called "NonValuable Residue (NVR)," which contains a variety of metals, and other toxic substances, including Brominated Flame Retardants (BFRs).
- Cement-based solidification/stabilization treatment technique is selected to improve NVR characteristics before disposal of in hazardous waste landfills.
- The aim is to study the efficiency of the stabilization and solidification of heavy metals contained in NVR from the waste PCBA using Portland cement.




## Materials and methods

Sample preparation

| Mixture | Setting | Curing | Test |
|---|---|---|---|
| Replace cement with NVR = 0, 20, 30, 40% wt. of binder<br>Water/cement = 0.75<br>Sand/cement = 2.75 | 24 hrs. | 28 days | Compressive strength<br>Leachability (TCLP)<br>X-Ray diffraction (XRD)<br>Scanning electron microscopy (SEM) |

## Results

- The NVR powder from waste PCBA in this study was considered to be a hazardous waste because Pb, Cu, and Sb exceeded the regulatory levels, specified by Thailand Notification of the Ministry of Industry B.E. 2548 (2005) on Disposal of Wastes or Unusable Materials.

- The compressive strength of all solidified/stabilized NVR products meets the U.S. EPA requirements of unconfined compressive strength at 0.35 Mpa.

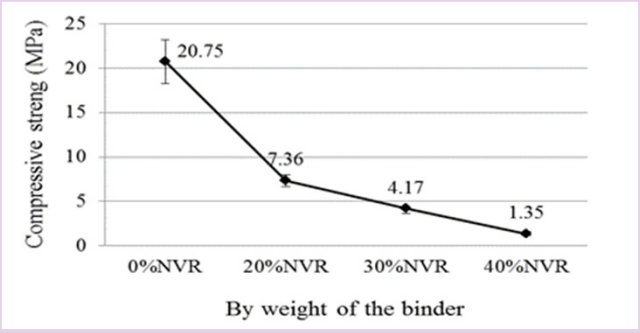



Figure 1 Average compressive strength of solidified/stabilized NVR products compared with blank sample

- The concentrations of heavy metals in TCLP leachates for all solidified/stabilized NVR products were below the regulation level specified by the U.S.EPA

Table 1 Metal concentrations in TCLP leachates

| Sample | Concentration (mg/L) | | |
|---|---|---|---|
| | Pb | Cu* | Sb* |
| Regulatory limit | 5 | - | - |
| Blank | ND | 0.13 | ND |
| 20%NVR | 0.20 | 0.60 | 0.24 |
| 30%NVR | 0.71 | 1.26 | 0.27 |
| 40%NVR | 0.11 | 2.26 | 0.14 |

- This study indicated that cement-based S/S treatment process was able to improve heavy metal immobilization and subsequently minimize potential environmental impacts in landfill disposal.

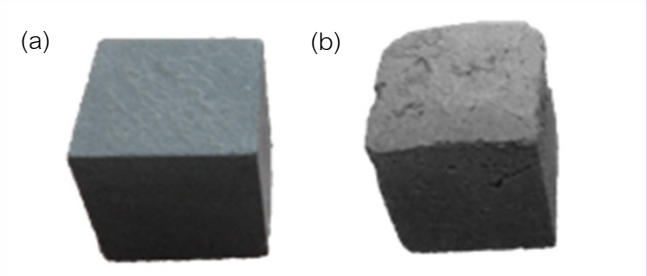



Figure 2 Solidified/stabilized products. (a) blank sample and (b) solidified/stabilized NVR product

Source: Tesanan S., Kwonpongsagoon S., and Kanchanapiya P. (2016). Solidification/stabilization of nonvaluable residue from waste printed circuit board assembly. *International Journal of GEOMATE*, 11 (24), 2307-2313, and Best paper award from International conference on SEE-Mie2015, Japan.