Recovery of Valuable Metals from Flue Dust and Other Fines from Mechanical Treatment of e-Scrap

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WPI

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Introduction

E-waste

- The demand of electronic equipment has increased with the advance in technology.
- As a result of the revolution of technology, E-waste is rapidly increasing in the world.

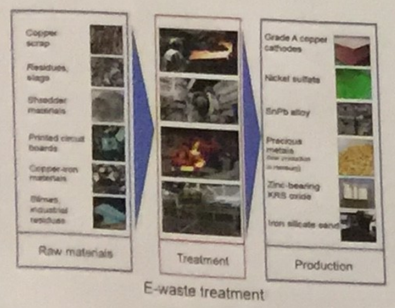
E-waste generated by country

- The world produced nearly 54 million tons of used electrical and electronic products (2012).
- The StEP Initiative forecasts that by 2017, the world will produce about 33 percent more e-waste, or 72 million tons.

Global E-waste market

- The global E-waste management market size is projected to reach USD 5.04 Billion till 2020 and an estimated CAGR is 20.6%.

What is the problem?

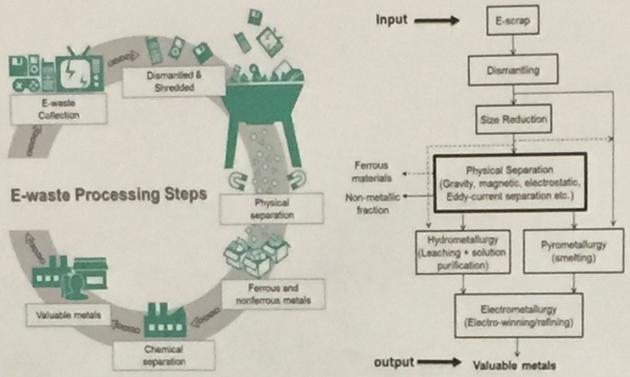


E-waste treatment

- Most of flue dust including precious metals generated during the smelting process are discarded and landfilled without recovery because of insufficient information about the components.

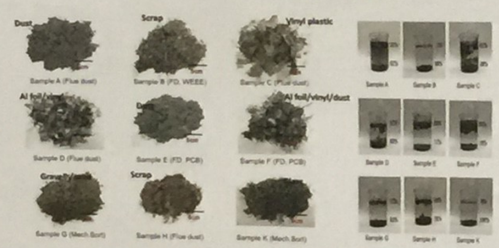
❖ This project will evaluate the potential for cost-effective and technologically viable methods for recovering valuable materials from the flue dust.

E-waste recycling processes



E-waste processing steps

Materials

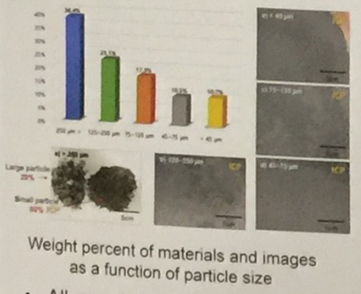


As-received samples

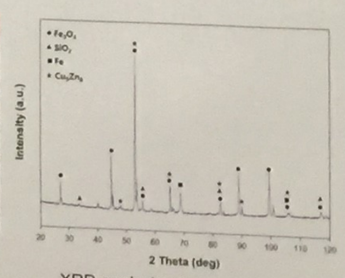
Flotation experiment

- 9 different types of flue dust are provided by Aurubis.

Size separation & Phase identification



Weight percent of materials and images as a function of particle size

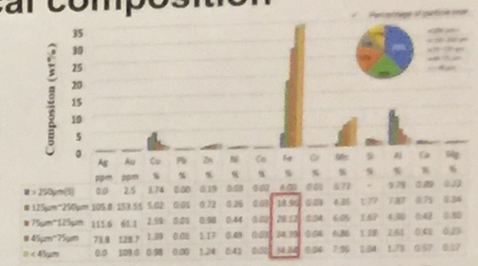


XRD analysis of sample D

- All samples have a wide range of size distributions and it has to be classified by size since compositions of materials were different with variations of size. To classify the materials by size, the different size of metal sieves (<250 μm, 125~250 μm, 75~125 μm, 45~75 μm, <45 μm) were utilized.

Chemical composition

Perkin Elmer Optima 8000 ICP-OES



ICP analysis of reclassification of sample D

Magnetic separation

	S Rosenblum	T Davis	S. Gostu	This study
Forward Slop [°]	25	20	17	15
Side Slop [°]	15	5, 10	15	15
Magnetic currents [mA]	10 ~ 50	10, 20, 40	10, 15, 20	5

$$Fe\ recovery = \frac{a \times b}{c \times d}$$

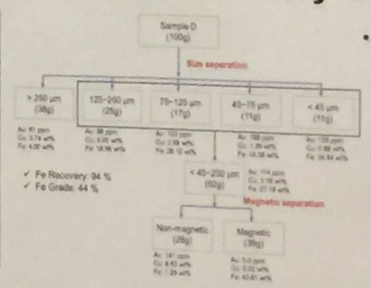
$a = Fe\ concentration\ (non-Mag)$
$b = mass\ (non-Mag)$
$c = Fe\ concentration\ (feed)$
$d = mass\ (feed)$

$$Fe\ grade = Fe\ concentration\ (Mag)$$

1. S Rosenblum, IK Brownfield, "MAGNETIC SUSCEPTIBILITIES OF MINERALS" (2000)
2. T. Davis, "Recovery of vanadium and titanium from iron slag" (2010)
3. S. Gostu, "Reuse Opportunities for Bauxite Residue" (2016)

Flowsheet for recovery of metals

Sample A		Initial	Non-mag	Mag
Ag	ppm	24	31	0
Au	ppm	114	141	0
Cu	%	3.19	6.62	0.53
Pb	%	0	0.38	0.01
Zn	%	0.89	1.17	4.02
Ni	%	0.45	0.07	0.30
Co	%	0.02	0	0
Fe	%	27.19	1.29	43.87
Cr	%	0.02	0.01	0.04
Mn	%	6.62	0.23	9.79
Al	%	4.90	11.58	0.46
Ca	%	0.65	1.13	0.06
Mg	%	0.29	0.46	0.12



Flowchart of the sample D after magnetic separation

- In non-magnetic fraction, the content of Au, Ag, Cu were increased after magnetic separation, while the Fe was significantly reduced from 27.19 wt % to 1.29 wt %.

Summary

- We conducted the size separation according to 5 particle and composition and phase identification were investigated by ICP and XRD.
- All of the samples have high Fe contents and it was confirmed as magnetite by XRD.
- Magnetic separation was conducted at the first recovery process for separation of magnetite.
- We are going to conduct the preliminary extraction tests with experimental variations.