Innovative System for the E-Scrap Treatment at Naoshima Smelter and Refinery

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Copper Smelters of Mitsubishi Materials Corp.

Naoshima (E’Cu:20,000t/m)

1917 Establishmet
1974 Commencement of 1st Mitsubishi Process
1989 Commencement of Precious Metal Process
1991 Commencement of Larger Mitsubishi Process
2002 Certificate the “Eco-Island Naoshima”
2004 Introduce the Incinerating Process

Onahama (E’Cu:25,000t/m)

1963 Establishment
1965 Commission of #1 Reverberatory Furnace
1973 Commission of #2 Reverberatory Furnace
1980 Treatment of used tire
1993 Treatment of the shredder dust
2007 Introduce the Mitsubishi S-Furnace
General Flow of the Copper Smelter and Refinery

**Raw Materials**
- Copper Concentrate
- Silica Sand

**Matte Production**
- Flash Furnace
  - 1250°C

**Blister Making**
- P.S. Converter

**Mitsubishi Continuous Process**

**Anode Production**
- Anode Furnace
  - 1200°C

**Electrolytic Refining**
- 65°C
  - Tank House

**Differentiate**

**Electrolytic Copper**

**Slime**

**Precious Metal Process**
Mitsubishi Continuous Copper Smelting Process

\[ \text{S-F’ce: } \text{CuFeS}_2 + O_2 + \text{SiO}_2 \rightarrow \text{SO}_2 + \text{Slag FeO-SiO}_2 + \text{Matt Cu}_2S-\text{FeS} \]

\[ \text{C-F’ce: } O_2 + \text{CaCO}_3 \rightarrow \text{SO}_2 + \text{Slag CaO-Fe}_3\text{O}_4-\text{Cu}_2\text{O} + \text{Metal Cu} \]

Large solubility of Fe\(_3\)O\(_4\)
Electrolytic Refining

-0.26 | Ni/Ni$^{2+}$
-0.14 | Sn/Sn$^{2+}$
-0.13 | Pb/Pb$^{2+}$

0.21 | Sb/SbO$^+$, Bi/Bi$^{3+}$
0.25 | As/AsO$^+$
0.34 | Cu/Cu$^{2+}$
0.47 | Te/TeO$^{4-}$

0.74 | Se/H$_2$SeO$_3$
0.80 | Ag/Ag$^+$
0.83 | Pd/Pd$^{2+}$
1.19 | Pt/Pt$^{2+}$
1.52 | Au/Au$^{3+}$

$E^o$ (V vs. SHE)

<table>
<thead>
<tr>
<th>Anode</th>
<th>Cathode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ni$^{2+}$</td>
<td>Cu$^{2+}$</td>
</tr>
<tr>
<td>SnO$_2$</td>
<td>BiAsO$_4$</td>
</tr>
<tr>
<td>PbSO$_4$</td>
<td>SbAsO$_4$</td>
</tr>
<tr>
<td>Coating</td>
<td>Suspended Solid</td>
</tr>
<tr>
<td>Peeling</td>
<td>(to Slime)</td>
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</tbody>
</table>

Suspended Solid (to Slime)

Cu$_2$Te, Ag$_2$Se
Pd, Pt, Au

Slime

Electrolytic Refining
Precious Metals Process

- De-copperized slime
- Flotation
- Tale
- Concentration
- Wet chlorination
- Se Reduction
- Se distillation
- 3N-Selenium
- Au Reduction
- Solvent Extraction
- Drying
- Washing
- Roasting and smelting furnace
- Cupellation furnace
- Silver electrolysis
- Silver electrolysis slime

Recovery of platinum and palladium

Favorable for Recycling

Mitsubishi Materials
Advantage of the Mitsubishi Process

1. Top Blowing Technology
   - High productivity
   - Chemical equilibrium condition
   - Very low copper loss

2. Lance and lumpy chute
   - Blowing air makes strong turbulence.
   - Vary shape of the scraps can be treated.

3. Continuous operation and closed melt launder.
   - Minimum fugitive gas
   - Sulfur recovery ratio is over than 99.99% !!
Combination of the Incinerator

- Effective usage of the melting capacity by reducing the E-Scrap volume.
- Continuous treatment of the Slag/Metal in the Mitsubishi Process.
- Minimize the metal loss by linkage treatment in the same plant area.

E-Scrap → Incinerator → Slag/Metal → Mitsubishi Process → Electrolytic Refinery → Precious Metals Plant

LBMA Certificated Au,Ag  LPPM Certificated Pt,Pd

Incinerating Plant in Naoshima
Customer Satisfaction — high reliability sampling

E-Scrap → Primary Crusher → Divider → Secondary Crusher → Rotary Divider → Analyze

Low Grade: < 20 mmφ  < 10 mmφ  < 5 mmφ
High Grade: < 20 mmφ

E-Scraps  Primary Crusher  Secondary Crusher
E-Scrap from all over the World

World E-Scrap Demand
Domestic: 84,000tpa  Overseas: 455,000tpa

Collecting amount of Mitsubishi Materials
Domestic: 25,700tpa  Overseas: 68,100tpa
(from 30 countries, 124 plants)
Conclusion - Conviction of the E-Scrap Business Global Player

Mitsubishi Materials Corporation established strong E-Scrap treatment business with environmental friendly process.

• Zero Emission
  – Recover the metals / precious metals under the low metal loss.
  – All of the materials are fixed into the product.
  – Keep the strict environmental regulation in Japan.

• Advanced Technology
  – High efficiency treatment at the Mitsubishi Process
  – Combination of the Incinerator and the Mitsubishi Process

• Customer Satisfaction
  – Established the high reliability sampling technology.
  – Developed the automatic sample preparation for the assay.
  – Minimize the environmental impact by the Mitsubishi Process.