Our Initiatives on Tailing Dams and Copper Slag

Response to dam collapses resulting from the Great East Japan Earthquake in 2011

Promoting Effective Use of Copper Slag, a By-Product of Copper Smelting

Masatoshi Kawada

Our Closed Mines in Japan

The JX Nippon Mining & Metals Group is controlling 39 closed mines in Japan.

Damaged by the Great East Japan Earthquake on March 11, 2011
Positional Relation
Between the earthquake and the mines

Color legend
(Earthquake intensity)

- Intensity 7
- Intensity 6 upper
- Intensity 6 lower
- Intensity 5 upper
- Intensity 5 lower

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Disaster at the Oya Mine

Cross-sectional View of the Dam before and after the Earthquake Disaster

- 40 thousand m$^3$ of tailings flew out from the tailings dam
- Due to the liquefaction phenomenon
- The tailings flowing out of the dam reached the point of 800m from the coast
- The ebbing tide of the Tsunami brought the tailings further downstream area
- Around 35 thousand m$^2$ of agricultural land was buried
- One private house was destroyed
- No human suffering
Overall Ground View of the tailings Dam

Bird-eye View of the Dam (Aerial Photo)
Scope Where tailings Flowing Out from the Dam Reached

- Area immersed by the Tsunami
- Area where tailings flowed out reached due to the earthquake
- Area where tailings spread by the Tsunami

Lateral Sides of the Bank
Lateral Sides of the Bank

Substruction of the Bank
Permanent Countermeasures at the Dam

Cross-sectional View of the Dam before the Earthquake Disaster

Cross-sectional View of the Dam after the Countermeasures

The Dam after the Countermeasures Taken

■ Completed in July 2013
Comparison of the Views of the Same Place

Just after the earthquake, as of April 1, 2011

After remedial work, as of May 25, 2012
Comparison of the Views of the Same Place

Just after the earthquake, as of April 1, 2011
After remedial work, as of May 25, 2012

Risk Assessments at Our Closed Mines

Kamikita mine, torrential rain countermeasures were implemented

- Conducting risk assessments at all closed mines
  - Earthquake
  - Torrential rain
About Copper Slag

- Iron silicate resulting from the bonding of iron in copper ore with silicate, during the copper smelting process
  - Crushed by high-pressure water to form black glassy granules
  - $2\text{FeO} \cdot \text{SiO}_2$
  - Copper Cathode 1 ton : Copper Slag 2 tons
  - The components are physically and chemically stable
  - Does not dissolve thanks to the slag’s glass-like properties

Features of Copper Slag

- High density
  - Decomposed granite soil 2.7 : Slag 3.5

- Great permeability
  - Greater than natural sand’s
  - Stable over a long duration
  - Usable as an alterable of sand

- Even grain size
  - Concentrating distribution between 0.3mm and 3mm

- High hardness
  - Harder than natural soil

- Compaction does not occur
  - Unlike soil, compaction does not occur when stuffed into a container
Application of Copper Slag

Concrete fine aggregate
- The most popular application of copper slag is iron source used in cement
- Occupying 35% in whole volume of concrete
- In view of environmental protection, becoming popular as an alternative of natural sand
- Not provoking alkali-aggregate reaction

Application of Copper Slag

Sandblasting material
- Very hard
- Having surface projection, due to its needle crystal structure
- Suitable for stripping of rust and paint from a ship, bridge and tank, and polishing of a face of weld
Application of Copper Slag

Stabilizing submarine soft ground: *the sand compaction pile method*
- As a pile, casting slag into soft ground
- Enhancing shear force resistance, by creating composite ground
- Exuding water in ground

Filler for caissons (hollow concrete structures)
- Higher specific gravity than sand's
- Lower-cost filler for caissons

Engineering to put slag into a caisson (left)
After engineering (below)
Effective Utilization of Slag in Japan

- The growing environmental awareness is driving rise in demand for copper slag.
  - As an alternative to natural resources
  - Reducing CO₂ emissions (170kg-CO₂/Slag-ton) and preventing climate change

- A government bureau has set a policy to utilize copper slag, as well as blast furnace slag, as concrete aggregate.
  - The Shikoku Regional Development of Bureau of the Construction and Transport Ministry
  - Extraction of sea sand has been prohibited in the Setonaikai area.

- The requirements for environmental safety and quality to copper slag have become increasingly stringent.
  - Japan Mining Industry Association has revised guidelines concerning the sales and purchase of copper slag.

Thank you for your attention.