

# Effective Use of Resources

## Basic Approach

The SMM Group's business centers on the utilization of the earth's limited and valuable resources. The effective use of resources is therefore considered an important managerial issue as we seek sustainable business development. Based on this understanding, the SMM Group has included "effective use of resources" as one of its Six CSR Areas of High Priority. We are working on a range of activities with the aim of being "a company that generates resources using innovative technology" as stated in our Vision for 2020. We are developing

technologies to effectively utilize natural resources, such as low-grade and hard-to-process ores, which have not previously been converted into resources, as well as technologies for recovering by-products from ores. We are also endeavoring to develop resource recycling technologies that effectively recover copper and precious metals contained in items such as used electronic devices, and valuable metals such as nickel from used batteries.

## Making Effective Use of Low-Grade Ores

The plant of CBNC<sup>1</sup> commenced full-scale operations in April 2005. Nickel oxide ore has been excavated from the adjacent Rio Tuba Nickel Mining Corporation's mine since before that time. However, while high-grade oxide ore with high nickel content buried deep in the earth was being mined, low-grade oxide ore with low nickel content existing close to the surface was not extracted. Because this low-grade oxide ore is said to make up around 70% of all nickel oxide ore resources worldwide, there was global demand for the development of technology that would allow it to be processed.

Recovering nickel from this low-grade oxide ore requires a hydrometallurgical technique called High-Pressure Acid Leach (HPAL). Large-scale production using this process requires a high degree of equipment engineering and operational skill. Industry players the world over have been struggling with the application of HPAL technology, but SMM overcame many technical hurdles to become the first company in the world to successfully apply HPAL technology to commercial production. Turning previously unusable low-grade ore into resources also has tremendous significance in terms of effective resource utilization.

In order to make full use of this HPAL technology, SMM embarked on its Taganito Project in 2009. The project entailed the construction of a large HPAL process plant with an annual

production of 30 kilotons of nickel in the Taganito District on Mindanao Island in the Philippines. The project progressed well, and operations at THPAL<sup>2</sup> got underway in autumn 2013, and in August 2014, achieved a monthly production of over 3 kilotons.

1. Coral Bay Nickel Corporation (CBNC)  
Shareholders: Sumitomo Metal Mining Co., Ltd. (54%), Mitsui & Co., Ltd. (18%), Sojitz Corp. (18%), Rio Tuba Nickel Mining Corp. (10%)  
Head Office: Rio Tuba, Bataraza, Palawan Province, Philippines
2. Taganito HPAL Nickel Corporation (THPAL)  
Shareholders: Sumitomo Metal Mining Co., Ltd. (75%), Mitsui & Co., Ltd. (15%), Nickel Asia Corporation (10%)  
Head Office: Taganito, Surigao del Norte Province, Philippines



Low-grade nickel ore for THPAL

## Using Resources Effectively through Recycling

Recovery and recycling of copper and copper alloys were readily pursued because of their high scrap value even before the 3Rs (reduction, reuse and recycling) were advocated as a catchphrase by society. Almost all the copper shavings generated by manufacturers of electric cables and wrought copper and copper alloy products are reused as raw material.

The SMM Group procures copper and precious metal scrap from the market and recovers valuable and precious metals from electric arc furnace dust and used printed circuit boards, among other sources.

In FY2016, the proportion of recycled materials such as copper alloy secondary materials and electric arc furnace dust was about the same level as in FY2015. Meanwhile, the ratio of

recycled materials in products increased slightly to 23.2% (18.1% in FY2015) as production of electrolytic copper from recycled copper materials was approximately 105 kilotons in FY2016.

### Percentage of Recycled Input Materials Used

FY	2014	2015	2016
Total volume of materials used (kt)	12,055	11,795	11,041
Recycled materials (kt)	264	233	222
Percentage of recycled input materials used (%)	2.2	2.0	2.0

## Slag as a Recycled Material

Copper slag is a by-product produced during smelting at the Toyo Smelter & Refinery, which manufactures electrolytic copper. The main use for copper slag (almost one-half of the total volume) is cement production in Japan and overseas. With an iron content of around 40%, copper slag is widely used as a source of iron for cement. Copper slag output in FY2016 was approximately 935 kilotons, with a sales volume of approximately 844 kilotons.

Hyuga Smelting Co., Ltd. manufactures ferro-nickel, a material used in stainless steel. It generated around 467 kilotons of ferronickel slag. Approximately 603 kilotons of ferro-nickel slag was sold as a recycled material, mainly to blast furnaces for steelmaking. With a magnesia content of around 30%, ferro-nickel slag is used as a source of magnesia for blast furnace flux. By taking advantage of their respective features, both copper slag and ferro-nickel slag are also used as substitutes for natural sand in fine concrete aggregate and harbor and civil engineering construction. In April 2016, Japan Industrial Standards (JIS) for fine concrete aggregate were revised and an environmentally safe quality was added. Environmental standards for slag have been strengthened, and ours comfortably meets these requirements.

## Recycling Precious Metal

SMM smelts and refines non-ferrous metals using ores from mines both inside and outside Japan as raw materials. However, in order to ensure limited resources are used effectively, we also apply smelting and refining technologies to the recycling of precious metals.

The Precious Metals Recycling Dept. of Ohkuchi Electronics Co., Ltd., uses discarded home appliances and electronic parts collected from across Japan, as well as the scrap produced



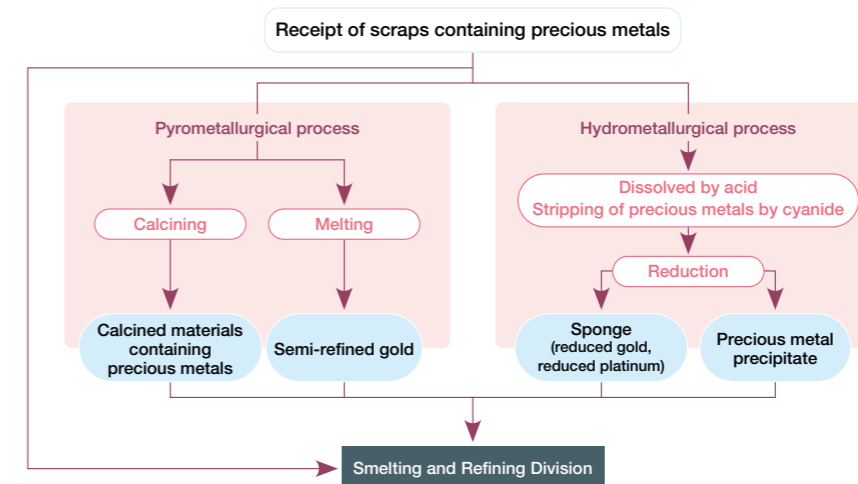
Some materials for recycling

during the manufacturing of these, as materials from which to recover precious metals.

Collected scrap is separated into parts made of plastic and the like, and parts that contain precious metals. The parts containing precious metals are concentrated by being finely crushed by a crusher and then heated to a high temperature in a furnace. Alternatively, they may be effectively concentrated through dissolution using chemicals, and the resulting material is then transported to our Toyo Smelter & Refinery. At the Toyo Smelter & Refinery, the concentrated material is refined together with raw material extracted from mines, and the precious metals such as gold and silver are recycled.

In recent years, devices that contain an abundance of rare precious metals, particularly cell phones, are being thrown away. It is the SMM Group's duty as a non-ferrous metal company to carry out the recycling of these.

## Precious Metal Retrieval: Flow Diagram



Semi-refined gold ready for transportation