

# Sustainable Minerals Development: Best Practices in ASEAN



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# Sustainable Practice in Minerals Development: Best Practices in ASEAN

ASEAN aspires to apply the concept of sustainable development to mineral resource development in the region and to direct ASEAN mineral cooperation towards ensuring that (i) sustainable practices are undertaken at every stage of minerals development, focusing on social and environmental well-being, and (ii) all mining activities in the ASEAN region are conducted sustainably, both during extraction and post-mining.

The need to promote environmentally and socially sustainable minerals development in the region is clearly articulated in Strategy 2 of the ASEAN Minerals Cooperation Action Plan 2016-2025 (AMCAP-III), Phase 1: 2016-2020.



## 2017 Finalists

### Best Practice in Minerals Mining

1. PT. Nusa Halmahera Minerals - Indonesia
2. RioTuba Nickel Mining Corporation (RTNMC) - Philippines
3. Siam Cement (Kaeng Khoi) Co. Ltd. - Thailand

### Best Practice in Minerals Processing

4. PT. Antam (Persero) Tbk. – Indonesia
5. MMG Lanxang Minerals Ltd. - Lao PDR
6. OceanaGold Mining Corporation – Philippines

### Best Practice in Minerals Distribution

7. PT. Amman Mineral Nusatenggara - Indonesia
8. Pipat Korn Co. Ltd. - Thailand

## Recognising best practices through the ASEAN Mineral Awards

The ASEAN Mineral Awards was established to honour ASEAN mining companies which have made outstanding contributions towards the promotion of sustainable minerals development in the ASEAN region. It recognises contributions involving actual impacts on community development, implications on ASEAN minerals supply, human resource development, productivity and resource efficiency, and actual measures to address health and safety and environmental performance. The Awards are conferred based on the *Guidelines for the ASEAN Mineral Awards* and are contested in three categories:

- *Best Practices in Minerals Mining*
- *Best Practices in Minerals Processing*
- *Best Practices in Minerals Distribution*

The 1<sup>st</sup> ASEAN Mineral Awards (AMA) will be launched during the ASEAN Ministerial Meeting on Minerals in November 2017 in Nay Pyi Taw, Myanmar. The first set of Awardees will be announced in that launch.

## Documenting the best practices

This first set of best practices on minerals development in ASEAN features the finalists of the 1<sup>st</sup> ASEAN Mineral Awards. It features a range of mineral products and processes: mining of nickel laterite in the Philippines; quarrying for limestone in Thailand; processing of ferronickel in Indonesia, copper cathodes in Lao PDR and gold ore in the Philippines; and, distribution of copper concentrates from Indonesia and feldspar minerals in Thailand.

The practices documented here also span a wide range: contributions to community development in the social and economic arenas, human resource development and employee welfare, health and safety management, environmental management including the management of effluents, emissions,

noise and water use, biodiversity conservation, progressive rehabilitation and rehabilitation of ex-mine areas, innovations in materials and processes, innovations in technology and application, and of course, resource efficiency and productivity. One notable common thread in all of these best practice examples is an evident commitment and drive to sustainable development and practice.

The aim is to document and feature these best practices as a set of inspiration. It is the ASEAN minerals sector cooperation's first attempt – the first in many – to make these best practices available to inspire innovations and spur good practice. Through this publication, real world examples within the region are offered to the mining and minerals industry and to its public, to show how sustainability can be pursued in minerals development and to demonstrate that the development of our mineral resources does not necessarily involve trading-off development with sustainability.

*This publication was prepared by the ASEAN Secretariat, with permission from the respective companies to use information submitted through the 1<sup>st</sup> ASEAN Mineral Awards, and with oversight from the AMA Board of Judges and the ASOMM Working Group on Sustainable Minerals Development.*

## Best Practice in ASEAN: Minerals Mining

# Nickel Laterite Mining in Rio Tuba, Palawan, Philippines

### About Rio Tuba Nickel Mining Corporation (RTNMC)

RTNMC is engaged in **shallow surface mining** operations involving the extraction, sizing and sorting, crushing, screening and solar drying of nickel ore prior to shipping to customers overseas. It has a 40-year track record operating in Barangay Rio Tuba, Municipality of Bataraza in the southern tip of Palawan, Philippines.

RTNMC produces **nickel laterite ore**, comprising limonite and rocky saprolite with grades varying between 1.5 to 2.5% nickel. It exports high-grade saprolite and limonite ore to international buyers while it delivers low-grade ore to a local processing plant. Buyers transform RTNMC's commodity into various products such as for steel production, alloys, batteries, electronics and other products vital to modern society. Since 1977, RTNMC has supplied about 61 million WMT of lateritic nickel ore to the world market.

RTNMC is a subsidiary of Nickel Asia Corporation and is a major producer of nickel ore in the Philippines. It has a maximum annual production of 8 million tonnes of nickel ore.

### **Social development programs for host communities.**

RTNMC began implementing social development programs for its host communities, even prior to the Government's mandatory implementation of a *Social Development and Management Program (SDMP)* under the Philippine Mining Act of 1995. These services are delivered through its Corporate Social Responsibility programs and include support for (i) a Level 1 hospital, (ii) educational instruction from grade school to high school, (iii) indigenous learning systems (ILS) to provide education to help mainstream indigenous peoples into formal schools, and, (iv) housing units for indigenous peoples.

RTNMC's programs reach not only the immediate communities but the whole province of Palawan, such as in the construction of 13 classrooms and awarding of 41 iMac computers to nine public schools in different municipalities in the province. Partnership with the local government and the Coral Bay Nickel Corporation supported the provision of safe and potable water supply to almost all barangays of Bataraza with four Level II/III water systems and development of two hydropower facilities which also provide clean energy to the communities.

Some 22 beneficiary barangays (villages) in Bataraza and their respective Indigenous Cultural Communities have benefited under RTNMC's SMDP programs since 2004. RTNMC has worked alongside the communities through regular consultation, evaluation of programs and careful analysis of program outcomes. This has led to further improvements and to tailoring to the needs of the community.

**Impact to the local economy.** RTNMC's mining operations in barangay Rio Tuba has been the most significant driver in the economic prosperity of Rio Tuba and its host municipality of Bataraza.

RTNMC plays a big role in providing jobs and basic services to the surrounding communities as well as creating venue for an active economic hub with good support infrastructure.

RTNMC was also instrumental in developing the Rio Tuba Export Processing Zone through Presidential Proclamation No. 304 in 2002. This facilitated the establishment and hosting of other businesses which bring jobs to the immediate communities.

The company is formally acknowledged as the *28th Largest Corporate Taxpayer in the Philippines* in 2015 and the *Largest Corporate Taxpayer in the Province of Palawan* since 2014. In 2016 alone, RTNMC contributed nearly PHP 800 Million in tax revenues and PHP 41.3 Million in royalties.

### **Employee welfare and human resource development.**

RTNMC believes its continued commitment to employee welfare drives employees to give their utmost to the goals of the company. As of end-2016, RTNMC employs close to 700 people with a peak level workforce of about 1,700 employees. Salaries paid by RTNMC are about 8% higher at entry level compared to the mandated minimum wage.

RTNMC is similarly committed to employing competitive staff who are fully trained and oriented and who have high regard for environmental protection, safety practices, and service to the community. Employees attend capacity-building trainings, seminars, and courses to further enrich their knowledge and skills that contribute in the efficiency and quality of their execution of day-to-day deliverables. Other employee programs include Consumer's Cooperative, Loan Program, Sports Development, and Scholarships.

Support for work-life balance is strong, with a town-site facility complete with free housing, water and electricity and 24/7 security, as well

as recreational and sports facilities and basic institutions such as facilities for school and church.

RTNMC's commitment to maintaining a high standard of practice under the Philippine Labor Code and related laws has garnered it (i) a *Tripartite Certificate of Compliance with Labor Standards* in March 2014 for being compliant to the General Labor Standards, Occupational Safety and Health Standards, and Child Labor Law, and, (ii) a *Child Labor-Free Establishment Certificate* in October 2015.

**Safety performance.** RTNMC has a Safety, Health and Emergency Response program in place. Since December 2016, mine operations have logged more than 26 million Man-hours Worked without Lost Time from Accidents. RTNMC has been fully certified compliant to the standards of the ISO 18001:2007 last May 11, 2017. During the Annual National Mine Safety and Environment Conferences in the Philippines since 1985, it has also been awarded the *Safest Surface Mine Operation*, the *Most Improved Safety Performance Record*, and the *Best Safety Personalities*.

**Environmental sustainability.** The commitment to environmental sustainability in its mining operations focuses on continual improvements in pollution prevention and the mitigation of adverse environmental impacts through effective implementation of RTNMC's *ISO14001:2004 certified Environmental Management System*.

To manage waste, a solid waste management system is implemented through a Categorized Sanitary Landfill. Hazardous wastes are systematically collected and temporarily stored in a hazardous waste facility until hauling is done by accredited haulers and treaters.

To protect water quality, RTNMC maintains and regularly monitors ground and surface water quality by (i) defining and strategically installing drainages to direct water flow and ensure no silted water escapes from the area; (ii) designing pit walls and slopes to prevent rapid erosion that might escalate siltation; and, (iii) installing boulder toes as protection in large stockpiles. The Rio Tuba River is regularly monitored to meet water quality standards and an aquatic biota and coastal resource assessment is annually conducted to determine the impacts of mine operation on aquatic life and coastal resources.

To protect air quality, RTNMC deals with dust emanation and emission by (i) concreting main roads and road shoulders in their route for operation in populated areas; (ii) stationing street sweepers every 300 meters of the road to remove and scrape soil that may dry out and turn into dust; and, (iii) continued tree planting at roadsides to serve as trap and dust curtains. New equipment to measure particulate matters that may pose health hazards has been acquired.

Noise generation is meanwhile contained due to the relative isolation of the mine operations area.

RTNMC also employs progressive land rehabilitation wherein it immediately rehabilitates the mined-out portions of its tenement even before project closure or resource depletion.



**Replicability.** RTNMC has endeavoured to make responsible mining a reality in the Philippines, amidst the heavy scrutiny from various sectors of the mining industry. For its efforts, RTNMC has been awarded the Philippines' *Presidential Mineral Industry Environmental Award* in 2015 and the *Platinum Achievement Awards* for 2014 and 2016.

In addition to the Philippine government's recognition of its work and social and environmental programs, RTNMC also subscribes to various transparency standards and reporting in order to systematically measure its performance and sustainability in various criteria. These include its participation in the *Sustainability Reporting Initiative (SRI)* by ECC International and the *Extractive Industries Transparency Initiative (EITI)* as well as its ongoing work on the *Sustainable Management Online Tool (SMOT)* following the principles of the International Council on Mining and Metals to balance implementation of programs in relation to economy, governance, social and environment. RTNMC also hosts outreach to industry groups and universities to showcase its work and good practice.

## Best Practice in ASEAN: Minerals Mining

# Limestone Quarrying in Saraburi Province, Thailand

### About Siam Cement Kaeng Khoi Co. Ltd. (SKK)

SKK is engaged in **semi open cut mining** operations which involves quarrying limestone as feedstock for cement manufacturing. Mining operations involve the use of drilling equipment and blasting agents to break down big rocks into smaller pieces and also the transport to impact crushers to further reduce rock size. SKK's mining quarry is located in Saraburi province in Thailand, 130 kilometres northeast of Bangkok.

SKK produces the **limestone** to feed its associated cement manufacturing unit. The three main rock types available from the SKK quarry include reserves of 180 million tonnes of high-grade limestone, 120 million tonnes of low-grade limestone, and 60 million tonnes of shale. The SKK quarry can produce 10.7 million tonnes of limestone annually, which is fed to its manufacturing unit to produce 7.3 million tonnes of cement annually. SKK feeds 84% of its Saraburi limestone to its Clinker and Cement operations which in turn produces 13% of Thailand's national supply. About 87.2% of its cement production is used domestically and 12.8% is exported to Myanmar, Cambodia and Lao PDR.

SKK is a business unit under Cement and Building Materials Group of the Siam Cement Group (SCG) and was established in 1969 as the SCG's cement manufacturing unit, with an annual 7.3 million tonnes of cement capacity distributed domestically and overseas.

SKK implements an impressive array of programs in community and corporate social responsibility (CSR), human resource development and employee welfare, and health and safety environment. Below, however, we highlight SKK's best practices focusing on environmental management, mine rehabilitation and biodiversity conservation, and resource efficiency because these are novel in the region and potentially replicable.

**Environmental management.** SKK's commitment to sustainability-guided operations has won SCG multiple awards and recognition, a source of pride

for SCG and its stakeholders. Consistent with its pursuit of excellence in 'green mining', SKK is particularly proud of its adoption of a 'Semi Open Cut Mining' design for use in its quarries (Box 1).

SKK has applied *ISO14001:2015* to every SKK shop floor and has achieved the highest levels in the *Environmental Performance Assessment Program (EPAP)* certified by ERM Siam, for the years 2005, 2008, 2012, and 2015. SKK's environmental performance is also reviewed and evaluated annually based on the *Dow Jones Sustainability Indices (DJSI)*. This has helped SCG to be a leader in the DJSI Construction Materials Industry for the fifth consecutive year as well as to win citations as an outstanding company in ESG (Environmental, Social and Governance).

The Thai government has also consistently recognised SKK for its environmental management through the *Green Industry Level 5*, *Green Mining*, and the *CSR-DPIM Continuous Awards* from the Ministry of Industry as well as the *EIA Monitoring Awards (Excellent)* from the Ministry of Natural Resources and Environment.

**Mine rehabilitation and biodiversity conservation.** In SKK's aim to operate its business compatible with responsible mine operation and biodiversity conservation, SKK follows an established process of initiating its (i) mine closure plan, (ii) master plan for quarry area rehabilitation, (iii) quarry rehabilitation funding program, and (iv) and biodiversity management plan. SKK collaborates and uses external experts from universities, forestry experts, technology centres, and community stakeholders to put these together.

For instance, its biodiversity conservation plan is prepared by (i) establishing a quarry

#### Box 1. Semi-open cut mining design: innovations replicable in other mining environments



**Semi open cut mining** is a method of quarrying that combines Open Cut Mining and Open Pit Mining by leaving some forest (about 40% of the permission area) as a buffer zone along the quarry boundary line. SKK's semi-cut open cut quarry is the first in Thailand and in ASEAN to implement this method.

The technique reduces environmental impact, noise and dust pollution. It also preserves significant forest cover, minimises damage to the mountain ecosystem, and maintains better scenery compared to an Open Cut system. Semi Open Cut design allows for rehabilitation to be undertaken simultaneous with the production process.

The method is acknowledged as a best practice quarrying technique in 'Towards a sustainable cement industry', World Business Council for Sustainable Development Report (2002).

rehabilitation framework in a 3-phase, intensive 10-year process, (ii) undertaking an Ecosystem Services Review (ESR) in collaboration with the National Metal and Materials Technology Centre, and (iii) developing cooperation networks with stakeholders and experts to establish a format of biodiversity conservation suitable to the quarry region. SKK also pursued the *Chum Chon Chui Poh Project* to plant seedlings for quarry rehabilitation, in collaboration with schools within quarry areas. To enable continuous learning and awareness promotion, it also established a Mining Rehabilitation and Biodiversity Learning Centre that highlights mine operations with biodiversity conservation concerns.

The outcomes of SKK's conservation efforts indicate that its rehabilitated ex-mine area have the highest Biodiversity Index of 2.94, based on the SKK-commissioned study by the Faculty of Forestry of the Kasetsart University. The Biodiversity Index (per the Shannon Index and Similarity Index) were used to monitor and analyse the success of biodiversity conservation, compared to the original condition of the forest prior to quarry development. The SKK quarry has a Similarity Index of about 70%, as close to its original condition and based on the number of plant species found, whether planted or naturally grown.

For the management of water in its shale mining and cement production process, SKK uses an impact assessment tool for enterprise water use, called *Water Footprint*, to facilitate its water management plan. SKK considers this an important tool but is rarely used in Thailand. SCG recognized its importance and therefore initiated a study on how to implement *Water Footprint* for its cement group at the corporate level. This was done jointly with the Faculty of Engineering, Chiang Mai University using SKK as study site to pilot the *Water Footprint* assessment according to the Life Cycle Assessment of ISO 14046.

**Productivity and resource efficiency.** SKK has operated and monitored its mining activities under a concept of Effective Resource Management (ERM), where for instance, quarry resources are utilised to their maximum capacity and waste minimised, allowing mining waste to be useful and prolonging mine life by 12 additional years.

Over fifty years of SKK operations has afforded it with continuous opportunity to develop its knowledge-base and to benefit from knowledge shared from and with other SCG business units. This has allowed it to develop and pursue its best practices to the benefit of the company as well as its community (Box 2).

SKK has also publicised these innovations, including welcoming so far about 15,000 visitors from 300 different community, educational and government organizations to its Open House to not only feature the cement manufacturing

process but also to demonstrate its attitude towards mining governance.

### Box 2. Innovations leading to higher efficiency

<b>Zero-Waste Quarry</b> <i>(Issue: ensuring zero-waste to minimize industrial waste from collecting low-grade limestone)</i>	<i>Effective resource management by establishing the quality of resource, matching the raw materials and desired product quality, simulating desired quality, and designing the production plan to control for quality.</i>
<b>Resistivity Method to search for caves</b> <i>(Issue: safety risk from caves under the quarry site)</i>	<i>Use of the Resistivity Method to establish more precise location and size of underground caves to guide operations and anticipate with higher levels of safety procedures.</i>
<b>Improvement in Blasting</b> <i>(Issue: reduction of environmental impacts from blasting, e.g., noise, vibration, pollution and fly rocks)</i>	<i>Improvements such as use of delaying fuse and air deck to reduce blasting materials; communities are informed ahead of the blasting schedule and SKK employees are sent into the communities to observe blasting impacts to find room for further improvement.</i>
<b>No Secondary Blasting Practice</b> <i>(Issue: lessening environmental impact)</i>	<i>Adoption of other methods of limestone size reduction such as Surface Miner, Rock Splitter, Breaker and Ripper to avoid secondary blasting and reduce environmental impact of SKK operations.</i>
<b>One Way for Truck Parking</b> <i>(Issue: truck-related accidents)</i>	<i>Introduction of one-way parking as a safety procedure for trucks; also adopted lifesaving rules and speed locks to control speed limits.</i>
<b>Dust Control System</b> <i>(Issue: quarry dust)</i>	<i>Alternative ways to use quarry dust by reducing, controlling and recycling at point source and non-point source.</i>
<b>Biodiversity</b> <i>(Issue: mine site rehabilitation)</i>	<i>Stability rehabilitation methods that rapidly help increase biodiversity in the sites being rehabilitated without affecting quarry operations.</i>
<b>Machine Innovation</b> <i>(drilling machine re-design resulting in maintenance cost reduction of more than 15%)</i>	<i>Decades of experience in using and maintaining Drilling Machines in its operations brought to bear - allowing maintenance team to replace and modify machine parts to suit its operational requirements.</i>

# Best Practice in ASEAN: Minerals Processing

## Ferronickel Processing in Southeast Sulawesi, Indonesia

### About Southeast Sulawesi Nickel Mining Business Unit (SSNMBU)

Southeast Sulawesi Nickel Mining Business Unit (SSNMBU) is involved in nickel production, from upstream to downstream activities, including exploration, mine planning, mine production, minerals processing, and marketing. It uses a **rotary kiln and electric furnace process (RKEF)** for its mineral processing technology. SSNMBU manages 6,232 hectares of mining area covered by four (4) Production Operation Mining Permits located in Pomalaa, Kolaka District of the Southeast Sulawesi Province of Indonesia.

SSNMBU produced 20,292 tonnes of **nickel (Ni)** in 2016, which accounts for 80% of Indonesia's total ferronickel production and 5.94% of global production. Ferronickel with Ni content greater than 20% is mainly sold directly to end-users. In 2016, 45% of ferronickel production was exported to Korea, 38 % to India, 15% to China and 2% to Taiwan. SSNMBU's first nickel processing plant (FeNi 1) was established in 1976 with capacity of about 4,500 tonnes per year. The second plant (FeNi 2) with capacity of about 5,500 tonnes per year was built in 1996, followed by FeNi3 in 2007 with 12,000 tonnes per year. The plant expansion, optimisation and modernization project which was fully completed in 2016 is expected to increase SSNMBU's total capacity to 27,000 tonnes of nickel per year.

SSNMBU is among the six business units of PT ANTAM (Persero) Tbk, which is 65% owned by the Government of Indonesia and 35% publicly owned. SSNMBU's ferronickel sales of IDR 2.78 trillion in 2016, which was 31% of ANTAM's total net sales, was second largest contributor to ANTAM's total net sales.

#### **Impact on social and community development.**

To contribute to social and community development around its mine area, SSNMBU has implemented initiatives aimed at supporting the creation of new local businesses, improving educational and health services and supporting a socio-cultural program. Community member and stakeholder involvement is a must in every community program formulated by the company.

SSNMBU has conducted various **health** programs, including (i) the optimisation of public health facilities by providing additional medical equipment for local health centres, and (ii) optimising the quality of public health through, among others, provision of clean water and sanitation or toilets.

SSNMBU has also implemented **education** projects for the host community, such as providing scholarships to university students

and developing a Community Learning Centre to facilitate learning process outside classrooms/schools.

Specific assistance has also been provided to the Bajau community- indigenous minorities around its mining area who live in small boats with fishing as main source of livelihood. This included the construction of classrooms with toilet facilities for 315 students which greatly facilitated the quality of learning environment for the Bajau children.

**Human resource development.** As part of human resource development for its employees, SSNMBU transformed its Learning and Development Division into a Learning and Development Business Unit (LDBU). The LDBU is now used as service provider in the field of mineral mining to be later developed as ANTAM Corporate University.

**Health and safety performance.** SSNMBU implements the "ANTAM Safety Principles" to avoid or minimise safety incidents or potential incidents which subsequently leads to injury and to loss of work time.

Based on these safety principles, SSNMBU has passed 12 million hours without incident from 1 April 2016 until March 2017. SSNMBU has also issued a *Guidebook of Quality, Occupational Health and Safety and Environment* to impose these principles. The safety and environment principles which guide Occupational Health and



ANTAM Learning Development Centre



Safety implementation in UBPNs were developed based on *ISO14001* and *OHSAS18001*.

An SSNMBU Joint Occupational Health and Safety Committee has also been set up to organise activities to ensure safe and healthy working environment, including programs such as (i) Healthy Living Workshop, (ii) 'Healthy Living begins from Childhood', (iii) blood donation drives for the employees and their families, and (iv) assistance for employees who suffer from ailments such as tuberculosis and hepatitis.

**Environmental management.** To address the environmental impacts of its mining operations, SSNMBU's initiatives include environmental programs on:

- **Energy efficiency.** SSNMBU has reduced the utilisation of diesel consumption for its power plant by shifting to electric steam power plant. SSNMBU has also changed its combustion system for diesel engine to enable the selection fuels- marine fuel oil (MFO) and natural gas.
- **Waste utilisation.** SSNMBU has made efforts to salvage value from its processing waste, such as through the use of sludge MFO as fuel in the rotary kiln by transforming process waste into construction industry by-products.
- **Emission control.** Aiming to capture and reduce the number of particles released directly into the air and to maintain air quality, SSNMBU has completed construction of its Gas Cleaning Technology (GCT) project.
- **Sedimentation.** To prevent and reduce sedimentation in the river area, SSNMBU built a check dam buffer to body water flow before entering the river. Mangroves have also been planted to control sedimentation in coastal areas.

**Productivity and Resource Efficiency.** For cost efficiency and productivity optimisation, SSNMBU has increased its capital spending to enable its (i) shift to a conveyor belt system and modification of the rotary kiln with additional lifters, instead of using a hauling road system, (ii) installation of copper cooler furnace, and (iii) elimination of the use of dolomite in furnace operation. In addition, in 2016 SSNMBU built a coal steam power plant leading to 24% reduction of oil consumption and resulting in 10% reduction of energy costs.

### Innovations Potentially Replicable in Other Ferronickel Processing Companies

*SSNMBU is now operating a **slag granulation system** as the result of modifying the old technology using an excavator bucket. By applying this system, SSNMBU has reduced potential accidents as well as operation costs amounting to IDR 1.8 billion per year. SSNMBU has also modified its diesel generator fuel into a dual fuel system using marine fuel oil (MFO) and liquefied natural gas (LNG) leading to reduction in MFO consumption, flue gas emission and operation costs as well as increase in operational flexibility.*



**Waste Minimisation.** The processing activities of ferronickel generate wastes, such as dust from the rotary kiln, rotary dryer and furnace and MFO sludge from marine fuel oil. To recycle the dust, SSNMBU has been using a pelletizer with total capacity 50 tonnes per hour to transform this into briquettes. As for the MFO sludge, SSNMBU is producing sewage sludge from the waste oil treatment processes or as a settled suspension obtained from MFO. The sludge produced is as much as 5,000 litres per day which is then used in rotary kilns as fuel after water content reduction. SSNMBU has also utilised slag as side product smelted into construction products such as in paving blocks, bricks and road base.



# Best Practice in ASEAN: Minerals Processing

## Copper Cathode Processing in Savannakhet, Lao PDR

### About MMG Lane Xang Minerals Ltd. (LXML)

LXML operates Sepon, a **copper processing plant**, that produces 99.9% copper cathode using a whole-of-ore leach, solvent extraction and electro-winning (SX-EW) process. Copper cathodes are materials for production of cables, wires and tubes. The Sepon plant is located in Vilabouly, Savannakhet in Lao PDR and began operations in 2002.

LXML has consistently achieved copper production above nameplate capacity between 2006 and 2015. In 2015, Sepon produced 89,253 tonnes of copper cathode, exceeding nameplate capacity of 80,000 tonnes. In 2016, despite transition to processing lower grade, harder and more complex ore, Sepon was able to achieve 78,492 tonnes of copper production. LXML expects to produce 65,000 to 75,000 tonnes of copper cathode in 2017. About 70% of LXML's copper supplies the domestic market, accounting for 15% of Thailand's copper cathode requirements. The remaining 30% was exported to China. Before 2016, LXML supplied the copper markets of Vietnam, Malaysia, and Indonesia.

LXML is a joint venture between MMG Ltd., a global metals producer based in Australia, and the Lao PDR Government. LXML is 90% owned by MMG and 10% by the Lao Government.

**Impact on community development.** LXML has implemented various community development programs as part of its contributions to its local community. On **health**, LXML established the "1,000 Day Project to Improve Maternal and Child Health" through which, a total of US\$2.9 million was extended for Phase-1 and -2 of the project. During the Phase-1, the project reached 247,000 children under five and two. The ongoing Phase-2 is meanwhile targeting an additional 135,000 children in vulnerable districts.

Under its **community-led projects**, LXML established the *Village Development Fund* and the *Community Trust Fund* in support of livelihood improvement and community empowerment. Through these Funds, LXML has (i) built schools, roads, latrines, fish ponds, and potable water access, (ii) invested US\$2.4 million to implement 187 projects across 42 different communities, (iii) granted development projects, activities or facilities identified by villagers, and (iv) extended investments of US\$7.3 million to assist the District Government for improvement of basic service delivery in alignment with the Lao PDR National Socio-Economic Development Plan.

In terms of **income generating opportunities**, LXML established a *Business Development Program* (BDP) aimed at diversifying income opportunities, creating climate for new businesses to flourish, and assisting to build sustainable livelihoods for the community after mine closure. Under the BDP, LXML purchases US\$3 million (75% of its fruits, vegetables, in which local produce) through 30 local businesses which helped create 490 local jobs since the mine commenced.

LXML has also cooperated with other organisations in making its contribution to the

local community. For instance, in cooperation with the Netherlands Development Organization (SNV), LXML has assisted rice farmers to improve the quantity and stability of supplies of good quality milled rice through improved farming methods and rice varieties. The cooperation resulted in 59% increase in the productivity of rice farmers and enabled these farmers to self-produce seeds. With Ironbark Citrus of Australia, LXML has also created a citrus industry in Vilabouly. In cooperation with GIZ and AUSAid, LXML has been involved in the *Rural Areas-Access to Finance for the Poor* Project by improving **access to credits and savings services**.

As part of its efforts to respect and preserve **cultural heritage**, LXML has sponsored archaeological research in partnership with the Lao PDR Department of National Heritage, Ministry of Information, Culture and Tourism and James Cook University, Australia. The excavation at Sepon, for example, has uncovered a history of mining and settlement dating back 3,000 years.

The Sepon mine area is in one of the most bombed districts of Lao PDR that results in unique challenges to mining operations and agricultural production. LXML has invested US\$40 million in the **clearance of unexploded ordnance (UXO)** which was the result of the drop of approximately 260 million bombs in Lao PDR between 1964 and 1973, of which 80 million remained unexploded. Through the program, LXML has thus far cleared around 3,800 hectares of land, destroying over 45,000 UXO items.

**Human resource development for employees.** Under its employment policy, LXML offers preferential recruitment for locals, which helps maintain the support of local communities.

It also provides training and development for employees, as follows: (i) US\$3 million in tertiary scholarships for Lao employees to study in Australia since 2002; (ii) over 100 trainees in various technical and administrative disciplines since 2000; (iii) 53 apprentices in the Lao-German Technical College; (iv) US\$100,000 support in electrical, tools, and other training resources to the Savannakhet and Vocational school; and over 100 Lao nationals in superintendent and supervisory positions.

**Health and Safety Performance.** In its efforts to create a 'Sepon Mine Injury Free', LXML has continuously (i) improved safety systems and procedures, (ii) maintained a safe work environment, and (iii) increased employees' awareness of hazards and risks. As a result, LXML is able to maintain a low total recordable injury rate (TRIF), currently at around 0.56 (as of the end of 2016), which is, less than one recordable injury per million hours worked.

**Environmental Performance.** To support its compliance with international environmental standards in its operations, LXML invested approximately US\$17 million in environmental management, rehabilitation, and monitoring activities for the period 2008-2016.

LXML has involved local communities to succeed in its **waste and water management and rehabilitation works**, such as through: (i) bi-annual waste management awareness campaigns to communities around the Sepon mine, (ii) provision of funding support for the construction of Vilabouly's first landfill facility, and (iii) collection of 750 water samples monthly to ensure water quality for communities.

As part of its **rehabilitation and re-vegetation programs**, LXML implements initiatives to return disturbed areas and promote restoration to achieve biological stability. Between 2008 and 2016, LXML has (1) undertaken re-vegetation activities on 169.3 hectares of land, (2) utilised natural materials sourced from local business to stabilise land, and (3) planted 360,000 trees in the disturbance areas using locally sourced and propagated species.

LXML has also invested in **biodiversity mapping and preservation** aimed at managing vulnerable species close to the Sepon mine and maintaining species of high biodiversity value to Lao PDR. It also made financial contribution to the *Community-Based Crocodile Recovery and Livelihood Project*, to protect the *Siamese crocodile* that is listed by the International Union for Conservation of Nature and Natural Resources (IUCN) as a critically endangered species.

Operational, safety, community and environmental standards and performances are shared internally and externally with

key stakeholders via the company's annual 'Sustainability Report' and various other means.

### **Productivity and Resource Efficiency Acidic Solution for Grinding and Dissolving of Copper in the Milling Process**

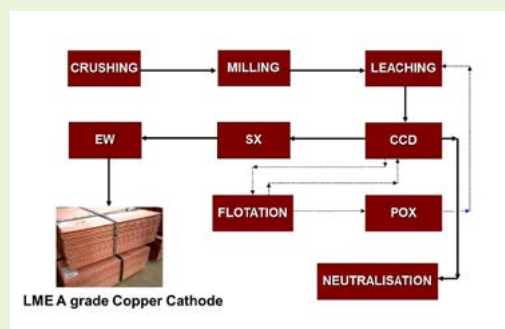
*Instead of using water, which is the usual practice, LXML has been utilising acidic solution to help grind and dissolve some of the copper. The use of the acidic solution has allowed approximately 90% of the copper in the slurry (or the mixture of ore and acidic solution) to be extracted by Sepon's copper processing plant.*

*After being heated and leached at 80°C for five hours, the slurry is then cooled and thickened, before being washed in a counter decantation circuit (CCD) to remove soluble copper. The copper-rich solution from the CCD is then clarified to remove the finer solids, before being pumped to a solvent extraction and electrowinning circuit.*

*For cost efficiency, Sepon has produced reagents (substances used to bring about a chemical reaction) on site. After the copper has been extracted from the slurry, the slurry is mixed with limestone and lime to neutralise the acidic solution.*

*Contaminants in the slurry are also made safe before being pumped to a tailings storage facility which is a valley impoundment with containment provided by engineered earthfill embankments and natural topography. The facility is also equipped with a seepage collection system. Clarified process water, as well as rain captured in the facility, is returned to the process plant for re-use or treatment prior to discharge in accordance with environmental regulations.*

**Figure 1. Sepon Copper Operation Process**



# **Best Practice in ASEAN: Minerals Processing**

## **Processing Didipio Mines Ore in Nueva Vizcaya, Philippines**

### **About OceanaGold Mining Corporation (OGPI)**

*OceanaGold (Phils.), Inc. (OGPI) is engaged in **optimized open pit mining** and an **underground sub-level open stoping with paste backfill operation**. OGPI operates the Didipio mine located in Kasibu, Nueva Vizcaya in the Philippines, with reserves currently estimated to be 1.69 million ounces gold and 0.21 million tonnes copper, sufficient for a mine life of 16 years. Open pit mining was completed in May 2017 while underground mining is expected to commence production in the second half of 2018.*

*OGPI began commercial production of high-grade **gold** and **copper** in April 2013 and has been making regular sales of dore bars and copper concentrate. Didipio Mine considers itself one of the lowest-cost gold mines globally, with All-In Sustaining Costs of US\$382 per ounce, achieved in 2015, along with cash costs of US\$17 per ounce of gold sold. The annual production ramped up from 2.5 million tonnes of ore processed in 2013 to 3.5 million tonnes per annum in 2015 and thereafter. Mineral production from 2014 to 2016 at Didipio is 336,242 ounces of gold and 69,244 tonnes copper.*

*OGPI is a subsidiary of OceanaGold Corporation, which currently operates in the Philippines under a Financial or Technical Assistance Agreement (FTAA No. 001) with the government dated 20 June 1994. The Didipio processing plant is currently operating at an annualized average throughput rate of 3.5 million tonnes per year, over 40% above its nameplate capacity. Average annual production is estimated to be 100,000 ounces of gold and 14,000 tonnes of copper per annum over the life of the Didipio mine.*

**Impacts on community development.** To realise its commitments to build capacities for its host and neighbouring communities, OGPI invested US\$13.8 million from 2013 -2016 – corresponding to US\$7.5 million for its *Development of Mining Communities, Sciences and Mining Technology* (DMC-SMT) program and about \$6.2 million for its *Corporate Social Responsibility* (CSR) programs. About 75% of the DMC-SMT resources are in turn allocated for the implementation of a *Social Development and Management Program (SDMP)*, which supports community infrastructure, education, health, capability building, enterprise development and sports and socio-cultural activities. The remaining 25% supports the development of mining technology and geosciences as well as information, education and communication campaigns.

Projects supported by OGPI's *We Care Program*, include the (i) Didipio Site Circumferential Road, (ii) *OceanaGold Competency Through Learning and Work Readiness Program*, (iii) *\$1 Million support for Education* through the high school building construction and financial assistance to support implementation of the government's K-12 program, (iv) Didipio Family Health Center, and (v) Water Distribution System. These represent \$4 million worth of initiatives under the *We Care* program.

Meanwhile, OGPI supports skills training and livelihood generation through local cooperatives as well as support for Didipio Community Development Corporation (DiCorp), a community-based corporation owned and managed by 393

local residents, organised with the assistance of OGPI through seed funding and capacity building. As a result, DiCorp was able to obtain long-term service contracts with OGPI which generated a gross revenue of USD 19M from 2011-2016. This enabled DiCorp to expand its businesses outside of Didipio.

**Initiative towards sustainability.** OGPI implements an Integrated Management System (IMS), through which it gained its *ISO 14001:2004*, *OHSAS 18001:2007* and *ISO 14001:2015* certifications. Its IMS has allowed OGPI to promote safety and better environmental safety performance through a safety culture, pollution prevention, and proactive environmental compliance. It has also aligned incentives to promote safety by elevating it as a key measure of individual employee performance.

**Health and safety performance.** OGPI achieved 10 million *Lost Time Injury* (LTI)-Free Man-hours on 18 March 2014. No deaths or fatalities were recorded from 2014 to 2016 in the Didipio Mine operation. Over the past 3 years, overall *LTI Frequency Rate* reduced by 96% and *All Injury Frequency Rate* by 10%. OGPI also saw a 15% improvement in its annual Safety Management System Audit.

**Environmental management and performance.** Driven by its strong focus on environment management, OGPI has implemented various programs for refining energy use efficiency and emission performance as well as managing impacts on water, air, aesthetics and biodiversity.

The following are the notable highlights of OGPI's environmental management:

- **Energy efficiency:** connection to the national power grid in 2015 instead of operating its fourteen 1.3 MW generator sets as its main power source led to significant reduction in carbon emissions and diesel fuel consumption (56.5% less or savings of US\$11.5 million)
- **Carbon sink program:** established a 312.37 ha. tree plantation, in addition to the newly established 122 ha. in Kasibu for 2016; total of 115,804 seedlings of various agroforestry and forestry species donated for planting in 2016 alone to various government agencies, community groups, schools and other stakeholders. In November 2016, OGPI planted its 1 millionth tree.
- **Water management:** recycled an average of 75% of the process plant's water requirement in 2016, thereby, reducing abstraction of water from local catchments, maintaining community access to water sources and reducing overall operating costs; collaboration with the International River Foundation (IRF) to bring coaching and mentoring to community members, leaders and regulators to advocate development of a catchment management plan to ensure improvements in water quality and maintenance of safe drinking water in the Didipio area.
- **Sedimentation ponds:** series of silt traps and sedimentation or stilling ponds in strategic locations to minimise silt directly flowing to the adjacent river especially during precipitation.
- **Vehicle wash bays with oil and water separator:** to help ensure water quality, adoption of a 'vehicle washing on designated area only' policy, which strictly implements washing in designated carwash bays equipped with oil and water separators.
- **Air quality and noise management:** regular maintenance for all back-up generator sets and heavy equipment; dust suppression activities carried out regularly and intensified during summer months; for noise from mine operations, physical and natural barriers, mufflers installation and limiting activities that generate undue noise during daytime hours only; odour monitoring on the sewage treatment plant; covering surge tanks with chimney and carbon filters.
- **Managing visual appearance:** progressive rehabilitation to manage its impacts to land and aesthetics. In 2016 alone, a total of 8,921 ha. of disturbed areas have been progressively rehabilitated and re-vegetated which is 159.30% higher than the 5.6 ha 2016 target area.
- **Biodiversity management and conservation:** conduct of annual Ecological Assessment and

### Innovations replicable in other mining environments

#### A. Use of SIBX as primary mineral collector

*OGPI uses sodium isobutyl xanthate (SIBX), instead of sodium ethyl xanthate (SEX), as the primary collector for the copper and gold. The SIBX is proven 100 times less toxic to aquatic life, compared to SEX.*

#### B. Innovations Leading to Higher Efficiency

<p><b>Flash Flotation and Gravity Recovery Circuit, including (1) increasing the valve sizes of the flash flotation circuits, (2) third stage tailings pump, and (3) increasing the diameter of the tailings line.</b></p>	<ul style="list-style-type: none"> <li>• Overall copper recovery steadily increased from 88.00% in Q1 2013 to 95.31 in Q1 2016, brought about by an average increase of flash recovery from 49.62% to 60.07%.</li> <li>• Overall gold recovery increased from 78.00% in Q1 2013 to a high of 88.03% to 90.36% in 2015, tracking model recovery.</li> </ul>
<p><b>Reduction of Water Consumption by installing a second return water line from Tailings Storage Facility to enable more process water to be returned to the plant.</b></p>	<p>The latest test in 2016 showed about 50% reduction in raw water use from 40 litres per second to 20.</p>

Biodiversity Monitoring since 2013 showing that 484 documented flora species representing 66% of the total recorded floral species in the whole province of Nueva Vizcaya. Of the 484 species, 23 which are listed under the Philippine Red List and the IUCN Red List of Threatened Species, are now treated as OGPI's flagship species for conservation and propagation through the OGPI nursery's Macrosomatic Clonal Facility.

- **OceanaGold Sustainable Agroforestry Incorporated (OGSAI):** established to support in the reforestation programs and provide livelihood and trainings to local farmers; it also manages the production site (nursery) of seedlings that are distributed for free to the Department of Environment and Natural Resources (DENR) and other groups.

## Best Practice in ASEAN: Minerals Distribution

# Copper Concentrates from Sumbawa Island, Indonesia

### About PT. Amman Mineral Nusa Tenggara (PTAMNT)

PTAMNT operates the Batu Hijau Project, a single **large-scale open pit mine** with porphyry copper-gold deposit, located in the island of Sumbawa in the West Sumbawa Regency in Indonesia.

The company's final product is **copper concentrate** (comprises two-thirds of the value of the mine), which also contains payable **gold** and **silver** minerals. Since its first shipment in December 1999 and through 2016, the Batu Hijau Project delivered 13.34 million wet metric tonnes of concentrates mostly to smelters abroad, including Japan, Philippines, Korea, China, India and Germany and a small portion delivered to domestic smelter PT Smelting Gresik. The total value of these shipments is about US\$19.43 billion equivalent to 3.6 million dry metric tonnes of copper, 248 tonnes of gold, and 830 tonnes of silver.

PTAMNT, formerly PT Newmont Nusa Tenggara, is a company wholly owned by Indonesian stakeholders following its acquisition by PT Amman Mineral International in November 2016. The mine was designed at its peak operation for ex-pit production at 600,000 tonnes per day and sag mill production at 120,000 tonnes per day. However, since the Batu Hijau mine has now entered its final mining phase, the ex-pit production has significantly reduced to 300-400,000 tonnes per day.

#### **Educational programmes and public relations.**

PTAMNT has pursued capacity building programmes including public education and campaign about the efforts or strategy being pursued towards community development. These included the use of health cadres, public discussions on tailing permit, beach clean-up day actions, and environmental prince and princess ambassador quizzes. A participatory rural appraisal (PRA) process was used to develop its community development (ComDev) program and monthly visits for community groups to the mine site are scheduled, to among others, facilitate community understanding of its pit and tailing discharge system. PTAMNT also has a system of communicating environmental issues in advance through community (sub-district) representatives.

Likewise, PTAMNT's bold initiative to use social media such as *Facebook* (214,742 likes), *twitter* (12,916 followers), and *Instagram* (4,712 followers) to share information with its public, holds the distinction for being the only Indonesian mining company to do so. *Batu Hijau* has been recognised for this with a *Golden World Award* in 2016 from the International Public Relations Association (IPRA).

**Contribution for local development.** The project has generated state revenues of US\$3 billion between 2000 and 2016. It has also contributed about 25–37% of the Province's Gross Regional Domestic Product (GRDP), and 75-99% of the West Sumbawa Regency's GRDP in 2006 and 2011.

The presence of the Batu Hijau mine project has brought very significant direct and indirect benefits to the local community. Direct benefits are fiscal revenues, infrastructures, capacity

building and soci-cultural programs. Indirect benefits include economic and employment generation, improved accessibility, public services, social and cultural interactions, and expansion of government administration.

PTAMNT has been implementing social responsibility programs to improve the quality of life and prosperity of the community around the mine through the following programs:

- **health:** building of community health centres, child and maternal health care, and provisions for potable water.
- **education:** scholarships for all education levels, provision of books and computers for schools and libraries, and building of new schools and renovation of existing schools.
- **livelihood:** coaching for farmers, funds for micro- and small-business initiatives (US\$ 553,000 in 2016) for rice and corn intensification program, irrigation dams and channels, marketing and promotion of local handicraft, food and drink products, promotion of tourism, public markets renovation, public road improvements, and provision of electric power and piped water into the Tongo village.

#### **Welfare and career development and training.**

Various training programs are designed and provided to meet company requirements and standards and to satisfy employees personal development. These include: (i) students programs (hands-on experience and research); (ii) general/management training; (iii) safety; (iv) mobile equipment; and, (v) licensing/certification. In 2016 alone, a total of 37,831 people participated in the training programs which were equivalent to 353,954 training hours.

**Health and safety performance.** Aiming to bring safety and environmental awareness into the company work culture and efforts towards 'zero harm' performance, PTAMNT has implemented

- mandatory standard operating procedures (SOPs) for each of the high-risk jobs and work permit requirement to perform such jobs.
- annual safety refresher training for all ID holders (i.e. employees, contractors and residents).
- enabling 800 of its employees to earn government-certified safety supervisors status.
- health and safety campaigns through monthly meetings, posters and self-owned dedicated radio broadcast.
- online reporting and tracking of accidents and follow up actions using the *Cintellate Environmental, Health and Safety Software*.
- risk analysis for identified risks, using pre-set of matrices of measuring likelihood and its corresponding consequences, and designed mitigation plan.

**Environmental management and performance.** PTANMT has used the Cintellate Software through which all environmental accidents are reported and recorded into an intra-net based application and connected to emails of all supervisors and above. It allows follow up actions to be monitored and its status will be closed after the case is solved, otherwise it will keep pop up in the reminder alerts. PTAMNT has also installed monitoring and pre-warning system devices site wide, such as a warning system to anticipate the Santong river overflow which prevents mine water from entering the river, and a geotech radar system at the pit to pick any slightest slope movements.

In 2009, PTAMNT recorded *40 Million Man Hours without LTA Award* from Newmont Mining Corp and passed the ISO 14001:2004 certification. In terms of mine closure, PTAMNT had reclaimed and re-vegetated 820 ha, accounting for 29.6% of the originally cleared area for the project.

**Waste minimisation.** Waste produced by the Batu Hijau operations are handled as follows:

- waste rock: stockpiled around the pit rim in a manner by which water seepage is contained from directly flowing into the natural water system.
- tailing waste: sea-bottom-placement method chosen since on-shore tailing placement would require over 2000 ha. of forest land; routinely monitored.
- hazardous and toxic materials and substance (B3): carefully packaged and temporarily stored before being shipped out to certified collecting agents, disposed into a medical incinerator, or

to be mixed into blasting materials and power plant fuels.

- domestic waste: treated in sanitary landfills and water treatment facilities and managed in accordance with permits and regulations.

**Potentially replicable innovations.** PTMANT has pursued initiatives that may spur good practice in other mining companies, such as:

- ✓ **power use efficiency and emissions reduction** resulting in efficiency energy ratio of 2.73% in 2015, amounting for 63,648 MWh. The CO2 reduction was 51,665 tonnes in 2015 or equivalent with an efficiency energy ratio of 3.95%. Meanwhile, PTAMNT recorded an average NOx reduction of 214 tonnes/year in 2015, resulting from the utilisation of Selective Catalyst Reduction (SCR);
- ✓ **production of copper concentrate from sludge** units water treatment plant, instead of being brought up back to the pit waste rock dump area - total of 15,812 tonnes of sludge have been processed between 2013 and 2016;
- ✓ **Leaching Precipitation Floatation (LPF) study** to improve mineral recovery from the ore stockpile by 8% and reduce effect of oxidized stockpile;
- ✓ **application of Sodium Hydrosulfide (NaHS) solution** to optimise mineral recovery by allowing sludge taken from the water treatment plant to be processed into concentrate. Between 2013 and 2016 as much as 15,812 tonnes of sludge was processed; and,
- ✓ **installation of a tsunami warning system** in the town site and surrounding villages which is connected to employees' and selected community leaders' mobile phones – a first for a mining project in Indonesia.



## Best Practice in ASEAN: Minerals Distribution

# Feldspar Mineral Products from Tak Province, Thailand

### About Pipatkorn Co. Ltd. (Pipatkorn)

*Pipatkorn is engaged in **feldspar mineral distribution** which involves (i) hauling mine feldspar mineral from the feldspar mine to the mineral processing plants, and (ii) transporting the processed feldspar mineral from the mineral processing plants to customers' factories. The business is located in Pipatkorn's mine concession in the Wangprachop Sub-District, Muang District in the Tak Province of Thailand.*

*Its distribution fleet includes 27 ten-wheel trucks, three 18-wheel semi-trailers, and nine 18-wheel full-trailers to transport feldspar from the mine areas to Pipatkorn's three mineral processing plants and from these processing plants to customer factories. This fleet is supplemented by 30 full-trailer operated by contractors.*

*Pipatkorn is the second largest feldspar mineral supplier in Thailand. It distributes 270,000 metric tonnes per year to the ceramic, glass, and sanitary ware industries nationwide. The final products of Pipatkorn's customers are further exported to various countries in Asia, Europe and America.*

*Pipatkorn began operating in 1989. The company's Mineral Distribution Department operates its feldspar distribution business alongside its mineral mining and processing operations.*

**Contribution to community.** Pipatkorn's initiatives to contribute to its local community include:

- **water supply:** access to water supply for the local community during dry season for agricultural and household use;
- **material and aggregates for building material:** donation of granite material for building material or aggregates for road construction within the community and the surrounding areas;
- **community facilities and infrastructure:** building materials for local school and community facilities, water tank towers for local communities
- **support for educational facilities and materials:** construction of the educational technology building for the primary/secondary school located near the mine area and resources towards educational supplies/teaching aids.  
health surveillance fund to support annual health check-ups, accident and emergency health care.

### **Environmental, health and safety performance.**

To pursue its efforts towards "green mineral

distribution," Pipatkorn has various measures to minimise the environmental and social impacts of its operations. These include addressing the following impacts:

- **Air pollution** from dust caused by hauling trucks, minerals dumping and loading: (i) water spray truck to depress dust on road surface; (ii) sprinkler system to depress dust in the loading area; (iii) water spray bars to depress dust at loading station and to clean truck wheels before exiting to public roads; (iv) dust monitoring at source and receivers; (v) use of latest models of canvas to cover trucks; and, (vii) stockpiling indoors to reduce dust dispersion.
- **Noise pollution** caused by mineral distribution machines: (i) designated times for mineral distribution from the run-off mine at 0800 – 1700 hours and for finished mineral products at 0800 – 2200 hours; (ii) compliance with laws and regulations on truck payloads in public routes; and, (iii) noise monitoring by using Sound Level Meter for 3 consecutive years during the dry season (April–May) and cold season (November–December).





### Innovations on current practice

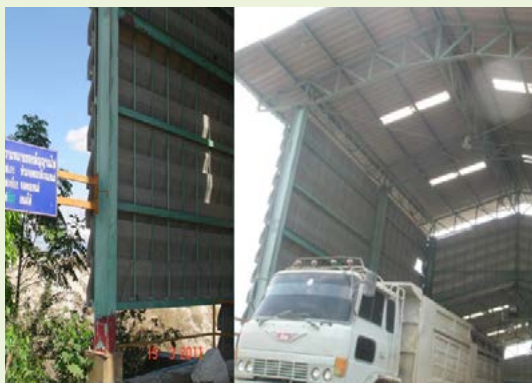
Pipatkorn successfully improved on its blasting practice and therefore the efficiency of its distribution operations by controlling the range of rock sizes fragmentation during blasting. This was done through its **Special Rock Blasting Program** where the sizes of rock fragmentation were made to conform to sizes more easily accommodated by Pipatkorn's loading and hauling machines. The proper size range of blasted ore (run-off mine feldspar) allowed for more efficient operational performance. It is an innovation on blasting procedures that may be replicated by other companies operating in minerals distribution. The program's benefits include

- reduced cycle time for loading and hauling
- reduced operating costs, especially the cost of wear and tear of bucket loader and truck tires
- increased production rate
- improvement in safety rate

Environmental impacts (i.e., smoke/emissions from excessive exhaust emission spewed by loaders and trucks as a consequence of overloading) are less. Overloading is common with larger blast sizes because it is harder to be precise with or to muck out large rock stockpiles.

### Innovations leading to higher efficiency

<p><b>Cycle time management</b> (Issue: dependence on the use of loaders and trucks - the productivity of mineral distribution depends upon the cycle time of both machines)</p>	<p>Application of the cycle time management allows Pipatkorn to improve productivity, reduce accidents to zero, and to minimise operating cost.</p>
<p><b>Critically economical time control program</b> (Issue: the loaders and trucks require frequent repair and high maintenance costs. Delayed maintenance of these machines may adversely impact on productivity and efficiency)</p>	<p>The program provides automatic alerts for maintenance time for the loaders and trucks which leads to efficiency of these machines and significant decrease in operating costs.</p>
<p><b>Stock pile underneath the construction site</b> (Issue: outdoor stock piles cause dust leading to air pollution)</p>	<p>Placing the stock pile indoors or under the construction site can minimise dust dispersion and avoids moisture and rainfall thereby significantly improving product quality.</p>
<p><b>Reduction of loss and dilution of minerals during distribution activities</b> (Issue: Minerals which are lost and diluted during distribution impacts on wastage and resource efficiency)</p>	<p>To control for loss and dilution of minerals, implemented procedures such as (i) specific design for the gradient ramp and drainage system, (ii) imposing a speed limit for trucks operated within the mine and processing areas, (iii) limit loading level of truck tray, and (iv) regulation requiring the trucks to be covered with canvas.</p>





**ASEAN MINERAL AWARDS**



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