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CIRCULAR ECONOMY BUSINESS CASE STUDIES IN SOUTHEAST ASIA

Trimegah Bangun Persada

North Maluku, Indonesia
Mining and Metallurgy
tbpnickel.com
Analysis period: 2021-2023

Recycling Nickel Slag into Concrete Bricks

Business Spotlight

Trimegah Bangun Persada (TBP) is a major nickel producer facing multiple waste challenges from nickel ore smelting operations. The company innovated to transform its nickel slag, a by-product of ferronickel smelting, into bricks, promoting the concept of resource circularity. These bricks serve as eco-friendly alternatives to conventional terracotta or concrete bricks in road and building construction and for artificial coral reef structures. By recycling its slag, TBP is significantly reducing waste disposal volumes. Looking ahead, TBP aims to expand the distribution of its recycled slag bricks and explore new applications, such as converting slag into soil enhancers.

Trimegah Bangun Persada converts its nickel slag into bricks and artificial reef structures

Keywords

Nickel slag, Recycled slag bricks

Innovation

Design, Manufacturing, End-of-life management, Resource circularity

Analysis of Trimegah Bangun Persada

Context and baseline

Trimegah Bangun Persada (TBP) is one of Indonesia's largest nickel mining and minerals processing companies, which is exploring ways to mitigate the environmental impact arising from nickel processing waste. TBP operates an energy-intensive pyrometallurgical smelter to process saprolite nickel ore into ferronickel, producing a by-product known as nickel slag. The smelting process transforms around 10% of the processed nickel ore into ferronickel, and the remaining 90% becomes nickel slag. In 2021, the Indonesian government reclassified nickel slag from hazardous to non-hazardous waste, allowing it to be further processed for environmentally sound recycling and reuse. TBP sought methods to add value to its nickel slag while reducing the remaining amounts to be disposed off. With a government permit to process nickel slag, TBP is converting it into construction materials which substitute for concrete blocks and bricks. This conversion is managed by PT Hijau Lestari Perkasa, a TBP subsidiary specialising in appropriate waste management solutions.

Innovation

Innovation is key for Trimegah Bangun Persada's (TBP) approach to sustainability and resource efficiency. TBP recognised the potential of its nickel slag as an alternative construction material. It developed a process to manufacture recycled bricks with a mixture of 85% nickel slag, 10% fly ash (a by-product of coal burning in the company's power plant), and 5% cement. TBP conducts a lethal dose 50 (LD50) test, a toxicity characteristic leaching procedure (TCLP) test, and a sub-chronic toxicity test before manufacturing the bricks to ensure no harmful impact on environment and product is safe to the public. This not only diverts slag and fly ash waste from disposal, but also makes it possible to tap into new revenue streams, thus iillustrating that environmental stewardship and economic viability can go hand in hand. Moreover, TBP's forward-thinking approaches extend to research and development efforts that aim to expand the recycling of nickel slag beyond brick production. The company's ongoing studies explore methods for using slag for soil improvement, taking advantage of the high silicon and magnesium contents of this slag. Through these innovations, TBP not only aims to increase operational efficiency but also to advance sustainable practices in the mining and metallurgic sector, pursuing positive environmental and economic gains.

Circular Economy impact

TBP contributes to the circular economy transition through resource circularity, because ferro-nickel slag, a previously discarded by-product, is recovered and incorporated into bricks for application in the construction sector.

TBP has adopted nickel slag processing and recovery as its alternative waste management practice. The nickel slag is collected from the smelters at PT Megah Surya Pertiwi and PT Halmahera Jaya Feronikel, both subsidiaries of TBP located on Obi Island. In 2023, TBP recycled 644,234 metric tonnes of nickel slag, significantly exceeding their initial target of 97,000 metric tonnes. From 2021 to 2023, the company produced 9 million bricks in different sizes and shapes. TBP plans to build a housing area with these recycled nickel-slag bricks, which have also been used to build residential housing, infrastructure, and other facilities on Obi Island, specifically for constructing buildings, roads, water pipes, and similar infrastructure projects. The recycled bricks replace regular concrete bricks, so there is an additional benefit of substituting sand and aggregates that would otherwise be required to produce these bricks, which – depending on the source – would mitigate the effects of sand and aggregate mining on the environment, landscape and hydrology. Moreover, the recycled slag bricks use less cement (5%) compared to regular concrete bricks (typically ~ 10% cement by weight).

Thus far, only 15% of TBP's total nickel slag was recycled in 2023. Unused nickel slag continues to be sent to a designated area for secured, environmentally sound slag back-filling. Looking ahead, TBP intends to reuse nickel slag for improving soil quality in minesite rehabilitation and artificial reef structures, as the company's aim is to increase the recovery and recycling rate for the nickel slag generated by their ferronickel smelters.

Business and market impact

The nickel slag recycling process at TBP produces bricks with premium strength and material properties that are well suited for specific applications in construction. TBP asserts that these bricks are extremely durable, non-absorbent, and possess a strength of 250 kg/cm². The bricks undergo rigorous quality and safety tests to comply with relevant regulations. In 2024 TBP was still only using the bricks within its own operations and projects, with a possibility for future scaling up to some 1.2 million bricks monthly for potential third party users.

Stakeholders

Trimegah Bangun Persada's (TBP) nickel slag recycling initiative succeeds because of close collaboration among its subsidiaries: PT Megah Surya Pertiwi and PT Halmahera Jaya Feronikel, both nickel smelters, and PT Hijau Lestari Perkasa, the manufacturer of the recycled bricks. This cooperation within the same business group facilitates an integrated implementation strategy as well as research, enabling lower development costs and improved operability. The Indonesian government played a crucial role by setting standards, issuing permits, and establishing regulations that ensure nickel slag management complies with environmental and product quality standards, as well as circular economy commitments. Additionally, the Indonesian Ministry of Industry conducts active research on nickel slag recycling and encourages companies to adopt this practice. Local governments also support the initiative by using recycled bricks for constructing pedestrian pathways.

Implementation

Initially conceived as Trimegah Bangun Persada's (TBP) solution to waste management, the nickel slag recycling initiative also offers a valuable economic opportunity. Waste management is a tightly regulated facet of the mining and minerals processing industry, with TBP's initiative becoming permissible only after the recent Indonesian government reclassification of nickel slag as non-hazardous waste[1] if the slag passes the mandatory lethal dose 50 test (LD50), the toxicity characteristic leaching procedure (TCLP), and the sub-chronic toxicity tests. Previously, nickel slag had to be fully disposed of in specially designed containment areas. It is obvious that the acceptance of waste recycling of mining and minerals processing residues hinges on national waste regulations. TBP manufactures bricks only from nickel slag that has passed the mandatory toxicity tests. Currently, TBP is using the bricks to build a new housing area on Obi Island.[2]

Takeaways

The mining and metallurgical sector faces significant environmental challenges, including the management of waste from smelters, and slag in particular. Trimegah Bangun Persada exemplifies how applying circular economy principles can turn these challenges into opportunities. By recycling nickel slag from ferronickel smelting, the company is not only mitigating environmental risks but is also unlocking new economic potential. This success is grounded in continuous technological research, innovation, and a steadfast commitment to sustainable waste management.

1 https://www.nandp.or.id/files/The%20Management%20of%20Hazardous%20Waste%20in%20Mining.pdf
2 https://tbpnickel.com/sustainability/human-rights/we-and-the-community/the-new-kawasi-settlement

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