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CIRCULAR ECONOMY BUSINESS CASE STUDIES IN SOUTHEAST ASIA

VICEM Hoang Mai

- Hoang Mai, Nge An Province, Viet Nam
- Construction material/cement
- ximanghoangmai.vn
- Analysis period: 2022-2024

Resource Efficiency Through Improvement of Kiln System

Business Spotlight

VICEM Hoang Mai Cement Joint Stock Company (hereafter referred to as VICEM Hoang Mai) is part of the Viet Nam National Cement Corporation. The company has been operating for over 2 decades and supplies essential materials for the building sector. Because cement manufacturing is energy and emissions-intensive, VICEM removed the operational inefficiencies of the plant by improving the kiln system. This kiln improvement increased equipment efficiency and productivity, improved thermal and electric energy efficiency, and allowed the use of lower-carbon alternative fuels, to reduce energy consumption and emissions. The results of this intervention have been remarkable: production capacity has been increased by 12.5% (from 4000 metric tonnes of clinker/day to 4500 metric tonnes/day); heat consumption has been reduced to less than ≤ 800 kcal/kg clinker; the concentration of NO_x emissions has been reduced by 100–150 mg/Nm^3 which resulted in reducing total NO_x emissions, and allowing the use of alternative fuels in the cement kilns, namely low-grade coal with a thermal value of <5,500 kCal/kg, and municipal solid waste. The improved kiln system of VICEM Hoang Mai demonstrates a circular economy solution that improves both energy efficiency and production capacity, while minimising GHG emissions.

Keywords

Energy efficiency, Emissions, Low-grade coal

Innovation

Manufacturing, Resource efficiency, Resource substitution

Analysis of VICEM Hoang Mai

Context and baseline

Cement production is a rapidly growing sector, and is important for construction and infrastructure development that enables growth of the national economy. However, cement manufacturing is energy- and emissions-intensive. Therefore, it is critical to develop and implement technological options to increase production while ensuring environmental protection for sustainable development of cement industry.

VICEM Hoang Mai started operations in 2002 with a design capacity of 4000 metric tonnes of clinker/day, using dry technology with a 3-pedestal rotary kiln and a 5-stage cyclone preheater tower, and a fuel mixture of coal varieties with calorific values of 6800 kCal/kg and 6000 kCal/kg. Over the years, the burning efficiency of coal declined, the pressure drop in the heat exchanger cyclone system increased, and the sedimentation efficiency of the cyclone declined, contributing to lower heat recovery in the cooling system. Moreover, the declining availability of high-grade coal forced the company to use lower-grade coal with a calorific value of less than 5500 kCal/kg, occasionally dropping even lower to 4500 kCal/kg. This increased total energy consumption (to 839 kCal/kg clinker) and increased NO_x emissions (a 20%–50% increase in the concentration of flue gases). Inspired by the prospect of simultaneously increasing production capacity, improving energy efficiency and reducing greenhouse gas (GHG) emissions through good manufacturing techniques, VICEM Hoang Mai upgraded its kiln system in 2022 to be able to use low-grade coal efficiently and to co-fire waste while ensuring clinker quality, thereby reducing energy consumption and GHG and NO_x emissions.

Innovation

VICEM Hoang Mai implemented innovations in equipment, controls and operations of its main cement kiln to improve the efficiency and productivity of clinker manufacturing, while using lower-quality coal and partially substituting waste for coal as alternative fuel. The innovation principally addresses cement production by replacing the off-line calciner with an in-line calciner to increase the burning time of coal in calciner. This improves the heat-exchange ability of the mixture in the calciner and allows the use of low-grade coal or municipal solid waste as alternative fuel in the cement kilns. The innovation also includes kiln-hood renovation to change the heat recovery location, as well as an upgrade of auxiliary equipment (motors, fans, etc.),

Construction of new kiln system

New kiln system in operation

helping to speed up the cooling process and thereby reducing energy consumption. The deployment of this integrated new solution is novel to the cement sector in Viet Nam.

Circular Economy impact

The innovation of VICEM Hoang Mai has created multiple environmental benefits and has contributed to two circular economy strategies.

First, resource efficiency is achieved in cement production through the reduction in energy-use intensity. Thermal energy consumption intensity was reduced by 40 kCal/kg of clinker, while the electricity consumption in the kiln stage was also reduced by 7%.

Second, the new system allows the use of low-grade coal and municipal solid waste as alternative fuels in the cement kilns, which illustrates a resource substitution strategy. VICEM Hoang Mai can replace coal/fossil fuel in the cement production process by 10%–30% by using municipal/solid waste as alternative fuels.

By reducing heat consumption and replacing non-renewable fuels with low-grade coal and municipal solid waste as alternative fuels in the cement kilns, the company reduced its NO_x concentration from a level of 600–800 mg/Nm^3 to a level of 550–700 mg/Nm^3, thus contributing to air emissions reduction.

Business and market impact

The economic benefits of renovating the kiln system at VICEM Hoang Mai are remarkable in terms of increased revenues and production cost savings. The production capacity increase of 12.5% has created an economic benefit that – according to market conditions at the time of the investment – was conservatively estimated to reach VND 8.8 billion per year (approximately EUR 325,000). Reducing coal consumption for clinker production by 40 kcal/kg of clinker creates a reduction in production costs by about VND 42 billion yearly (approximately EUR 1.5 million). Reduction in electricity consumption for clinker production by over 2 kWh/metric tonne of clinker would bring the production costs down by VND 4.9 billion annually (approximately EUR 180,000). The estimated payback period for the investment is 1.2 years.

The new system was jointly developed and designed by VICEM Hoang Mai with the Viet Nam Institute of Building Materials, and all the materials and equipment were procured on the domestic market, thus avoiding the expense of hiring foreign experts for system design and installation – a cost which would have represented about VND 20 billion (approximately EUR 730,000), and maintenance costs of about VND 1.5 billion annually (approximately EUR 55,000).

Stakeholders

The new technology implementation at VICEM Hoang Mai was made possible through the collaboration of numerous stakeholders including Viet Nam National Cement Corporation (VICEM) and Viet Nam Institute of Building Materials (VIBM). VICEM Hoang Mai partnered with municipal solid waste collection companies and other industries or suppliers for the input used in cement production. The company also worked closely with VICEM, MONRE, and MOIT in the development of the Nationally Determined Contributions of the Industry sector, and thus helped accelerate industry adoption of more sustainable and lower-carbon building materials. The case of VICEM Hoang Mai demonstrates the power of partnerships for achieving sustainable and green manufacturing in Viet Nam. Other cement companies in Viet Nam could also benefit from the technical solutions developed and implemented by Hoang Mai.

The new technology brings benefits not only to VICEM Hoang Mai but to the whole society in terms of emissions and solid waste reduction, along with job creation. Using large quantity of solid waste in the production process contributes to reducing waste streams to landfill. The company is also a key contributor to economic growth by providing employment and paying taxes to its host localities, as well as giving business opportunities to various suppliers and service providers.

Implementation

In 2022, new technical solution was developed and implemented by VICEM Hoang Mai jointly with VIBM. The work was of great significance for VICEM Hoang Mai since it was the first technology developed and adopted by Vietnamese scientists in the cement sector. All materials and equipment were procured, manufactured and installed by Vietnamese suppliers which helped to reduce implementation costs and time, while also supporting the development of the domestic equipment manufacturing sector.

The renovated kiln system allows the use of municipal solid waste as alternative fuel in cement manufacturing. The use of waste as alternative fuel at VICEM Hoang Mai may vary from 10%–30% depending on the market demand and availability of resources. The substitution rate is expected to reach 50% in the long run.

Takeaways

The use of technological options at VICEM Hoang Mai presents a readily available lever to both reduce GHG emissions and improve the economic efficiency of cement manufacturing.

This best practice and experience demonstrates to the Viet Nam cement sector that moving forward to ‘Natural Cycle – Zero Emissions’ makes good business sense.

Acknowledgements

This business case study was prepared within the framework of the Technical Advisory project: Mobilising Business Action for Circular Economy in the ASEAN countries under the EU SWITCH-Asia Policy Support Component for the sole purpose of documenting and analysing business experiences with the circular economy. The case study was produced by Le Ha Thanh (national expert, Vietnam) and reviewed by Rene Van Berkel and Thomas Thomas (regional experts) on the basis of information provided and validated by VICEM Hoang Mai JSC, Vietnam.

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