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CIRCULAR ECONOMY BUSINESS CASE STUDIES IN SOUTHEAST ASIA

Solusi Bangun Indonesia

- Cilacap, Central Java, Indonesia
- Cement
- solusibangunindonesia.com
- Analysis period: 2017-2023

Municipal Solid Waste as Alternative Fuel in the Cement Industry

Business Spotlight

PT Solusi Bangun Indonesia (SBI) Tbk is is a subsidiary PT Semen Indonesia (Persero) Tbk, the leading producer of cement and building materials in Indonesia. SBI is using pre-processed municipal and other solid waste as refuse-derived fuel (RDF) to partially replace low-grade coal in its cement kilns. The company collaborates with local governments to improve environmentally sound management of municipal solid waste (MSW), and using RDF reduces the company's CO_2 emissions. Under its sustainability goals, by 2030 the company plans to use of 1.4 million metric tonnes of waste per year (including municipal) as a contribution towards achieving the company's target of achieving a 29% reduction in CO_2 emissions compared to the 2010 baseline. The company is already operating an RDF facility at Cilacap District in Central Java Province, which it plans to replicate at its other production facilities in Banda Aceh and Aceh Besar Districts in Aceh Province, among others.

Keywords

Municipal solid waste (MSW), Refused-derived fuel (RDF), mechanical biological pre-processing

Innovation

Manufacturing, End-of-life management, Resource circularity

Analysis of SBI

Context and baseline

According to the International Energy Agency (IEA), the cement and concrete sectors emit around 7% of global CO_2 emissions, generated mainly during clinker production, when it is released from the reaction of limestone with other minerals at high temperatures; by using fossil fuel for process heating; and by using power for clinker grinding, mixing and other purposes.

At SBI, measures to reduce CO_2 emissions include a (partial) switch to lower carbon, alternative fuels. For the latter, SBI has explored various types and

sources for alternative fuel, such as biomass, industrial waste, and municipal solid waste (MSW). MSW is of increasing concern in Indonesia given the rapid increases in waste generation and insufficient and inadequate waste collection, management and disposal services and techniques. The Ministry of Environment and Forestry estimated that in 2022 the amount of MSW in Indonesia reached 33.9 million metric tonnes, up from 29.3 million metric tonnes in 2019. Throughout Indonesia, MSW is disposed mainly in uncontrolled landfills that constitute a risk for the environment and for communities, including foul odours, pests, seepage, and greenhouse gas (GHG) and other emissions, fire hazards, and landfill waste slides.

SBI began investigating the use of MSW as alternative refuse derived fuel (RDF) in 2013, when it was still part of the Holcim group. SBI selected its production facility in Cilacap to be the pilot project. The company obtained support from the Ministry of Housing and Public Works, Ministry of Environment and Forestry (with grant support from the Government of Denmark), and the governments of Central Java Province and Cilacap District. The RDF pilot project in Cilacap started in 2017 and after several trials was officially launched in 2020.

Innovation

SBI assigned its Nathabumi waste management division to provide waste management services to local governments and other waste generators and collectors, and to supply the RDF to be used in the SBI cement kilns. Despite the high calorific value of the plastics, paper, etc. present in MSW, Indonesian MSW cannot be directly fired in cement kilns or power stations because of the high levels of food and yard waste it contains, which results in high moisture contents of up to 55%–60%.

At its pioneering 160 metric tonnes/day Cilacap facility, SBI pioneered the implementation of novel waste management technology to pre-process MSW into a suitable RDF using a mechanical biological treatment process. A special plastic membrane is used to cover the MSW, which allows water to evaporate from the waste but prevents outside (rain) water from penetrating the drying waste. The process breaks down and dries the waste over a 21-day period and produces the RDF, an amount of approximately 50% of the incoming waste weight, plus an inert material, about 15% of incoming waste volume, which is discarded. The remaining 35% of the incoming waste volume has evaporated. The waste pre-processing facility was set up at the district's waste disposal yard, and provisions were created to allow informal waste workers to collect recyclable items (e.g. metals, cardboard, plastic bottles, etc.) from incoming MSW prior to shredding the waste for the mechanical biological treatment process.

A mechanical screening and treatment process is also being applied at a 50 metric tonnes/day landfill mining project in Jakarta. In addition, SBI uses in its Cilacap kilns on average 24 metric tonnes/day of RDF that has been produced with pyrolysis of MSW by the Banyumas district.

Circular Economy impact

The transformation of MSW into RDF as fuel for cement clinker production contributes to the circular use and recovery of materials and energy. Specifically, the use of RDF diverts MSW from landfill, recovers its energy, which substitutes for coal use and reduces its GHG emissions, and incorporates some minerals from the RDF fraction into the cement clinker.

The Cilacap RDF facility manages up to 160 metric tonnes of solid waste/day (up to 58,000 metric tonnes/year), which produces approximately 70 metric tonnes/day of RDF (up to 23,000 metric tonnes/year). With its calorific value of approximately 3000 kcal/kg, and the installed RDF capacity, SBI can potentially generate up to 210 million kcal/day (or 0.87 TJ /day) of thermal energy.

The RDF contribution remains small compared to SBI's total fuel requirements. SBI additionally uses selected industrial wastes with high calorific values directly in its kiln, including solvents, oil sludge, shoe soles, and used rags. In this way SBI was able to progressively increase the cummulative use of all its alterative fuels in all its kilns from 1742 TJ in 2020 to 2586 TJ in 2022, and during the same period their coal consumption decreased gradually from 26,157 TJ to 25,284 TJ.

Business and market impact

Although the investment has never been made public, SBI has invested a significant amount of money in conducting comprehensive research and feasibility studies on RDF, carrying out a pilot project, and installing additional equipment in the production facility for feeding RDF into the kiln. The company might be saving money from having replaced coal with RDF, but the details have not been disclosed.

The company is committed to pursing its sustainability goals, including the target of reducing CO_2 equivalent emissions per metric ton of cement by 29% by 2030, compared to the 2010 baseline. The road map to achieve that goal includes replacing fossil fuels with alternative fuels with lower carbon emissions. Along with Cilacap, SBI has engaged in talks with other local governments in the vicinity of their production facilities to supply RDF from their municipal waste streams (i.e Sleman for the Cilacap plant and Aceh Besar for the Lhoknga plant).

Stakeholders

The Cilacap RDF project gained support from the government in terms of funding, supporting facility and regulations. The government spent IDR 84 billion (approximately EUR 4.9 million), which was shared between the Ministry of Housing and Public Works, Ministry of Environment and Forestry (with grant support from the Government of Denmark), and the Central Java and Cilacap Governments. The Cilacap government issued a district regulation as an umbrella for the implementation of RDF. Since the RDF has been commercialised, the Cilacap government receives revenues from 'selling' the RDF, which is sold to SBI for IDR 300,000 per metric tonne (approximately EUR 18).

When developing the RDF facility, SBI focused not only on the technical side, but also on the social and economic aspects. The pre-processing facility was designed to accommodate the informal waste pickers so that they would not lose their source of livelihood. An indoor sorting area is provided for the informal waste pickers where they can safely sort any waste with value for reuse or recycling. They also receive health insurance and training opportunities.

Implementation

SBI, whose project was the first in Indonesia to be producing RDF from municipal waste, has certainly experienced barriers and challenges despite overall support and endorsement. One of its biggest challenges was to build a facility with a proven technology requiring a large financial investment upfront, and which is too costly to be covered solely by one company or a local government. For the RDF Cilacap project, SBI as the initiator spent several years engaging both national and local governments, collaborating with development partners such as Denmark to explore potential funding and working out how the project could contribute to broader national interests (waste management and climate action). It took considerable time to accommodate the interest of all partners to contribute to the project.

Another ongoing challenge is ensuring continuous operations to provide a consistent and reliable supply of RDF to SBI. There is a tendency in society to view waste management as a 'feel-good', philanthropic undertaking, which prevents the business-like operation of RDF facilities which is necessary for the industrial use of the RDF.

The lion's share of the potential for RDF production from municipal waste remains untapped in Indonesia, in light of the challenges of both continuity and quality of supply. As SBI required more RDF, it expanded its engagement beyond Cilacap to the neighbouring district, Banyumas, whose government has invested in their own waste facility to produce RDF through pyrolysis. Starting in 2023, Banyumas has been sending on average approximately 24 metric tonnes per day of RDF to SBI's Cilacap plant.

It is also a challenge keeping an open mind with regards to scaling up and replicating RDF projects, but especially to get governments to operationalize and implement the polluter-pays principle which is already embedded in Indonesia's environmental legislation. The local government believes it should be paid for supplying waste given its calorific value, and is thus not willing to share the cost needed to convert municipal waste to RDF.

Finally, it is also crucial to find a suitable break-even point between the investment and operational costs for pre-processing MSW and the operational savings that are being achieved with using RDF.

Takeaways

Preprocessing municipal solid waste into RDF as an alternative fuel suitable for cement making is a complex technical undertaking that requires setting up a complete waste value chain. It is equally necessary to obtain buy-in and support from regulators, communities and other stakeholders. Moreover, efforts are needed to ensure consistency in both the quality and the quantity of RDF production to meet the receiving industy's process requirements.

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