

Asia's plastic potential

With the highest consumption of plastic in the world and representing two-thirds of global cement production, five Asian countries provide the opportunity to address the worldwide issue of non-recyclable plastic waste.

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A total of 6.3bnt of plastic waste was created globally until 2015. Of this, only nine per cent was recycled, 12 per cent incinerated and 79 per cent dumped. If continued, 12bnt of plastic waste will be mismanaged by 2050.¹

The Norwegian-funded project Ocean Plastic Turned into an Opportunity in Circular Economy (OPTOCE) is a regional effort to address the main source of microplastics in the ocean, namely inadequate treatment of plastics on land. The project involves India, China, Myanmar, Thailand and Vietnam – countries that include the biggest rivers in the world and a population of almost 3bn people, of which half live near waterways.

Combined, these countries have the highest plastic consumption in the world, producing an estimated 176,000tpd of plastic waste, or around 64Mta, of which large volumes are dumped. OPTOCE aims to investigate and document how the involvement of resource- and energy-intensive industries, such as cement manufacturing, can increase the treatment capacity for non-recyclable plastic wastes (NRPW).

Collection of plastic in Binh Duong, Vietnam, January 2020



These five countries produce two-thirds of the world's cement, steel and electric power in tens of thousands of plants that use huge amounts of coal and contribute more than 30 per cent of the world's CO₂ emissions. Plastic waste is made of fossil fuel and contains more energy than coal. Therefore, replacing parts of this coal

consumption with non-recyclable plastic waste represents a win-win opportunity, preventing the plastic from ending up in the ocean and reducing greenhouse gas (GHG) emissions indirectly compared to dumping or incinerating the same waste.

The potential of integrating the energy-intensive cement industry with plastic waste management is enormous. However, it is important to show that it works locally. SINTEF's initial estimates highlight that the cement industry in the five countries can theoretically co-process all the plastic waste generated, provided reasonable distances are taken into account. This could amount to reducing the coal consumption by more than 60Mta.

The following sections outline current plastic production, consumption, waste generation and management, as well as the potential for co-processing non-recyclable plastic waste in India, China, Myanmar, Thailand and Vietnam.

China baseline

China is the world's largest plastic producer and consumer, producing 81Mt



Plastic waste is sorted into recyclable and non-recyclable fractions

or ~29 per cent of global plastic production in 2016.² For several years, China received the bulk of scrap plastic from around the world, processing much of it into materials that could be used by manufacturers. However, plastic waste/scrap imports were banned in early 2018, affecting the developed nations, which are struggling to find places to send their waste, and the developing southeast Asian nations such as Thailand, Vietnam and Malaysia, to which the wastes were directed.

China generates 440Mta of solid wastes. Estimated plastic waste generation is 48Mta. The main treatment of solid waste is incineration and landfilling, and only 11 per cent of collected plastic waste is recycled.³

China is the largest contributor of marine debris in the world⁴: 81 per cent of China's coastal regions are heavily polluted with plastic debris² and seven of the world's 20 most-polluting rivers are running through the country. The Yangtze River alone is estimated to discharge 0.3Mta of plastic to the East China Sea.⁵

In addition, China is the world's largest producer of cement, accounting for about 58 per cent (or 2.4bnt) of the global cement production in 2018. Co-processing is practiced in more than 100 cement plants and the average thermal substitution rate (TSR) is estimated to be eight per cent. Co-processing is now an important pillar in the Chinese waste management strategy and the circular economy, and an integrated part of the national 13th Five-Year Plan on Ecological and Environmental Protection. The Chinese cement industry co-processes 3.5Mta of raw municipal solid waste (MSW), containing 10-15 per cent plastic, and 2Mt of refuse-derived fuel (RDF), containing 30-40 per cent plastic. There is willingness and a large potential to increase the treatment of non-recyclable plastic waste by involving the cement industry.

India baseline

India has a low plastic consumption, 11kg/capita/year or 40 per cent of the global with 60 per cent of this present in two sectors: packaging, and building and construction. The country's Central Pollution Control Board (CPCB) has estimated that 9.4Mt of plastic waste (or 25,940tpd) was generated in 2017-18 from its studies of 60 Indian cities in 2015. The study found a plastic waste share of eight per cent in MSW. Compared to other OPTOCE partner countries, the plastic waste generation seems to be an underestimate. By 2031 plastic waste generation is expected to reach 31Mta.⁶

About 60 per cent of plastic waste, or 5.6Mt, is recycled. Of this total, 70 per cent is recycled by registered facilities (3.9Mt), 20 per cent by the informal sector (1.1Mt) and 10 per cent (0.6Mt) at home.⁷ There are approximately 4000 unorganised and 3500 organised plastic recycling units in India. The informal sector in India is known to be well organised and efficient, taking an important role in the waste collection and treatment systems.

However, India's Ministry of Housing and Urban Affairs (MOHUA) notes that the recycling of virgin plastic materials can be carried out 2-3 times only. After every recycling, the plastic material deteriorates due to thermal pressure and its life span is reduced. Therefore, recycling is not a safe and permanent solution for plastic waste disposal.

An estimated 2.5Mta of plastic waste is dumped, more than 1Mta sent to incinerators and 0.25Mta is sent to large cement companies for co-processing. The average collection and treatment efficiencies of solid wastes were 80 and 23 per cent, respectively. What is not treated is disposed either in landfills or open dumps. India is estimated to release 0.09-0.24Mta of

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marine litter and ranks as the 12th-largest contributor of plastic waste to the ocean.⁴

Utilising plastic waste as a bitumen substitute in road construction is gaining momentum. The Indian Ministry of Road Transport and Highways has made it mandatory for road developers to use waste plastic along with bituminous mixes for road construction, in urban areas. For every km of road, an estimated 1t of plastic waste can be used, replacing 10 per cent of bitumen. More than 1000km of rural roads have been laid in Tamil Nadu alone, using this initiative.⁷

The central regulation is Plastic Waste Management Rules (2016, amended in 2018), notified by the Ministry of Environment, Forest and Climate Change (MoEFCC). The ambition is to follow a waste-to-wealth pathway via recovery, reuse and recycling. India intends to eliminate all single-use plastic in the country by 2022 and several states have already banned single-use plastic. The Solid Waste Management Rules (2016) direct that non-recyclable waste of a



Non-recyclable plastic wastes in Binh Duong, Vietnam

calorific value of 1500kcal/kg or more should be used to generate energy either through RDF or as feedstock to prepare RDF. Highly-calorific wastes are to be used for co-processing in cement or thermal power plants. CPCB Guidelines for Co-processing of Plastic Waste in Cement Kilns (2017) describe detailed procedures

for collection, segregation, transportation and co-processing of plastic waste in cement kilns.

India has the world's second-largest cement industry, accounting for eight per cent of world production. The installed capacity exceeds 500Mta and production is over 330Mta. Estimated coal consumption is more than 55Mt. India has the most energy-efficient cement plants in the world. The present TSR is three per cent, but the industry aspires to achieve 25 per cent TSR by 2025.⁸ By achieving 10 per cent TSR, the cement industry can co-process more than 8Mta of plastic wastes containing segregated combustible fraction (SCF)/RDF.

During World Environment Day 2018, hosted by India under the theme of 'Beat Plastic Pollution', the country's cement industry pledged to co-process 12Mta of plastic waste by 2025. MoEFCC noted that processing various plastic wastes in cement kilns could go a long way to solving the problems.⁹

Around 46 of the country's 238 plants are currently using some amount of plastic, but the MOHUA is in talks with the Cement Manufacturers Association to increase the amount of plastic disposed at cement plants.

Thailand baseline

Thailand has the highest plastic consumption among the OPTOCE countries, estimated close to 75kg/capita/year.¹⁰ As per the Thailand state of MSW report 2016, MSW generation in Thailand is 27Mta, of which 5.8Mta is used, 7.8Mta is landfilled (29 per cent), 0.7Mta is incinerated (three per cent) and 11.7Mta is dumped (43 per cent). The share of plastic in MSW is 12 per cent,¹¹ which

OPTOCE Regional Forum and the 1st International Conference on Treatment Options for Non-Recyclable Plastic Wastes

Lessons learned from OPTOCE pilot demonstrations will be shared through a regional multi-stakeholder forum, enabling awareness raising, capacity building and replication across the continent. In conjunction with the 1st Regional Forum, the 1st International Conference on Treatment Options for Non-Recyclable Plastic Wastes will be organised by SINTEF in Bangkok, Thailand, between 12-13 November 2020.

The aim is to share and discuss experiences, practical applications, research and recent findings and information about current treatment practice for non-recyclable plastic wastes.

Case stories and research findings on best practices will be presented. The following techniques will be dealt with in the conference:

1. thermal treatment options: combustion with energy recovery (WtE), co-processing and energy recovery in energy-intensive industries such as cement, iron and steel and power plants, pyrolysis and waste-to-fuel technology, etc
2. re-use applications: road basement, building material, etc
3. landfilling/containment/dumping
4. regulatory issues and policy road maps
5. economic incentives.

Abstracts should be sent to the Organising Committee by 1 August 2020 – for further information: <https://int-nrpw-conference.com/> and <https://optoce.no/>

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The considerable volume of non-recyclable plastic waste in China, India, Thailand, Vietnam and Myanmar can be processed by the cement industry of these countries

indicates a plastic waste generation of 3.3Mta. The country has 104 landfills and 2380 dumpsites, containing close to 188Mt of plastic waste.¹² Jambeck et al (2015) estimates a marine debris release from Thailand of 150,000-410,000tpa – making it the sixth-largest polluter of plastic waste to the ocean.

The ASEAN chairmanship for 2019 was held by Thailand and the country played a key role in the Bangkok Declaration (2019). The Thai government has announced the national goal to reduce plastic waste leakage into the ocean by at least 50 per cent by 2027. PCD-MONRE is the responsible department for plastic waste data and management plans. Other ministries involved in waste management and regulations are the Ministry of Industry (Department of Industrial Works) and Ministry of Interior. The relevant waste-related policies and plans in Thailand include:

- ‘Road Map on Waste and Hazardous Waste Management’ – issued in 2014
- ‘National Solid Waste Management Master Plan (2016-2021)’ – issued in 2016
- ‘Alternative Energy Development Plan (2015-2036)’
- ‘Integrated Plastic Waste Management Plan (2017-2021)’.

Thailand has an installed cement capacity of 60Mta (2017). Most plants are in central Thailand, but a few are far south and far north along the western border. The major cement companies in Thailand, such as Siam City Cement (INSEE) and Siam Cement Group (SCG), co-processes industrial and household wastes, but there is scope for enhancing utilisation. The

country’s TSR is estimated to be over 10 per cent.

WtE incinerators are becoming popular in Thailand, and many are under development or in the planning stage. The co-processing industry sees competition from conventional WtE incinerators, which gets subsidies for waste treatment. The cement industry has the potential to use the waste efficiently in parts of the country, without the need to invest in WtE plants.

Vietnam baseline

Vietnam has a population of 96m, of which 70 per cent live in coastal areas and low-lying deltas.¹³ It is estimated that Vietnam generates 23Mta of MSW¹⁴ with plastics accounting for an average share of 12 per cent, or 2.8Mta. According to Jambeck et al, 0.28-0.73Mta of plastic waste is leaked to the ocean,⁴ making it the fourth-largest polluter of plastic to the ocean.

The main management option is disposal in 660 landfills or dumpsites and only 203 landfills are reported as sanitary.

Open burning in dumpsites is common practice. There are two operating WtE incinerators for electricity production, with plans to install more plants. Recycling is common in craft villages around the country. Poor

treatment methods are used for the recycling, causing pollution and health issues. The national strategy for integrated solid waste management targets collection and treatment of 90 per cent of solid waste generated in the urban centres by 2025. Of this, 85 per cent will be recycled, reused, energy-recovered or used for organic fertiliser production.

In terms of governance, the Ministry of Natural Resources and Environment (MONRE) is the nodal ministry for the implementation of the Environmental Protection Law (2015), while the Vietnam Environment Administration (VEA) is the technical environmental agency that supports MONRE. The Waste Management Department (WAMA) is specialised in waste management under VEA. On a local level the waste management is managed by provincial and municipal governments, including the People’s Committee (PC), the Department of Natural Resources and Environment (DONRE) and Urban Environment Companies (URENCO).

Vietnam has the fifth-largest cement industry in the world, producing 90Mt of cement in 2018 and with significant exports. While cement plants are distributed throughout the country, most are concentrated in the north. There is only one cement plant in Vietnam that co-processes waste on a daily basis, INSEE Cement’s Hon Chong plant in southeast Vietnam. The plant has a 5000tpd of clinker capacity and has been co-processing industrial wastes for the last 15 years. A few companies are considering starting co-processing.

Other cement companies are interested in establishing co-processing and await the required regulatory approvals. At present the country’s TSR is <0.5 per cent and therefore, co-processing can play an important role in integrated



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waste management, reducing the need for high investments in conventional WtE incinerators. It is estimated that by achieving a TSR of 13 per cent, all of Vietnam's plastic wastes could be treated in cement plants.

Myanmar baseline

The World Bank estimates Myanmar's household waste generation to be ~4.7Mta, containing 13 per cent plastic.¹⁵ Plastic waste generation is estimated to be about 0.6Mta. Myanmar has one of the lowest levels of plastic consumption among the ASEAN countries, or five per cent of the global average. There are more than 300 plastic recyclers across the country, mostly SMEs. Between 1-2 per cent of the plastic collected for recycling ends up as non-recyclable plastic waste with an estimated generation of 5000tpa.

The treatment practice is limited to landfilling/dumping. One incinerator with WtE is available outside Yangon, but a few more are planned. Yangon City Development Committee (YCDC) is planning to install one RDF production facility in Yangon. In big cities such as Yangon, Mandalay and Nay Pyi Taw, the city development committees are responsible for waste management. In townships waste management is undertaken by township development committees. The Environmental Conservation Department (ECD) is responsible for developing the country's waste management strategy and master plans. The Ministry of Information (MoI) is responsible for granting licences to plastic recycling industries and waste treatment companies.

According to a survey conducted by Thant Myanmar and Fauna and Flora International in 2019, it is estimated that 119tpd of plastic wastes run down the Ayeyarwady River with the potential release of plastic waste to the Indian Ocean.¹⁶ The Ayeyarwady river basin houses 60 per cent of Myanmar's population. Jambeck et al has estimated that 0.07-0.19Mta of plastic waste enter the ocean from Myanmar.⁴ The Fridtjof Nansen research vessel in 2018 revealed that the country's coastline is heavily impacted by microplastics.

By 2017 the cement capacity in Myanmar was approximately 10Mta. It is estimated that in the next few years, it will exceed 20Mta. In terms of fuel requirements, under the assumption that coal usage is approximately 20 per cent of

cement production, Myanmar would be requiring close to 2Mta of coal, of which the majority is imported. No cement plants in Myanmar are currently co-processing wastes. Moreover, there is no regulatory framework for co-processing in the country and the cement industry has not invested in facilities for the pre-processing or co-processing of wastes. There is limited or lack of capacity and competence in the industries and authorities regarding the co-processing of wastes in cement kilns.

Conclusion

Billions of tonnes of plastic wastes are accumulated in dumpsites/landfills or mismanaged around the world. Everyone is talking about recycling, but what do we do with all the plastic waste that is non-recyclable and slowly released into the ocean and the food chain?

Our initial estimates show that the cement industry in the five OPTOCE-countries can theoretically co-process all the plastic waste generated provided reasonable distances. This could reduce coal consumption by more than 60Mta. n

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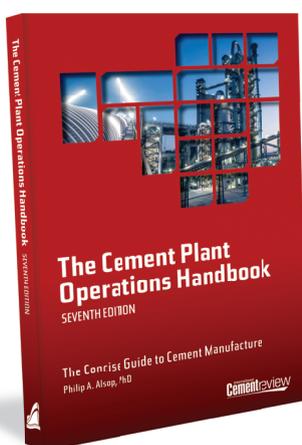
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