

Ocean plastic: an opportunity in the circular economy?

Initiatives are under way to address the global issue of plastics litter in the oceans. Norway's SINTEF highlights the use of co-processing in the Ocean Plastic Turned into an Opportunity in Circular Economy project.

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International action is key to addressing the most significant sources of plastics litter in the oceans, ie insufficient waste management in developing countries and emerging economies, especially connected to major world river basins, dumpsites, landfills and industrial hotspots. It is estimated that more than 80 per cent of marine debris comes from land-based sources with Asian countries among the top contributors to marine litter and microplastics.

The Ocean Plastic Turned into an Opportunity in Circular Economy (OPTOCE) project funded by the Norwegian government seeks to showcase that the involvement of resource- and energy-intensive industries, such as cement manufacturing, may increase the treatment capacity for non-recyclable plastic wastes and constitute a fundamental pillar in the circular economy.

Recycling of plastic wastes is the preferred option, but not all plastic waste is suitable for recycling. The demand for recycled plastics is low and the recycling sector has suffered from low commodity prices. In terms of resource efficiency, it is particularly important to prevent landfilling or dumping of plastic waste, where plastics might be converted to methane and microplastics.

Energy recovery from wastes (and plastics) in municipal solid waste incinerators with waste to energy (WtE) normally involves generation of electricity in steam turbines, but the efficiency is usually poor. Moreover, such plants are expensive to build and operate, they represent an additional emission source and produce large amounts of residues (fly ash, bottom ash, etc) that still need to be landfilled. Another challenge is the incineration of wet wastes in the rainy



season, which causes difficult burning conditions and results in poor emissions.

Countries with a cement industry may, to a certain degree, forego building expensive incinerators. Cement kilns are already in operation and may increase the waste treatment capacity significantly if integrated into the waste management strategy. This could represent a win-win solution as the plant would reduce their coal consumption by recovery of wastes and non-recyclable plastics, with an energy efficiency far higher than WtE plants. They are usually cost-efficient, do not produce any residues that need disposal and the emissions of greenhouse gases (GHGs) are reduced compared to landfilling or waste incineration.

Partners in OPTOCE

The five partner countries in OPTOCE – China, India, Myanmar, Thailand and Vietnam – currently have few environmentally sound treatment options for plastic wastes, but thousands of cement-, steel- and coal-fired power plants that use large amounts of coal and emit a large share of the world GHGs. Replacing

some of this coal with waste plastics (and MSWs) will be an environmentally sound practice compared to dumping or building new incinerators.

Pilot demonstrations

Co-processing is still at its infancy in most Asian countries and OPTOCE aims to carry out pilot demonstrations in local plants to investigate the feasibility. The objective is to prove the concept under various local conditions and circumstances as well as to cover a range of representative scenarios, uncover limitations of the practice, and provide scientifically valid answers to common myths and perceptions.

The pilot demonstrations will document the performance, ie describe the plastic waste co-processing capacity, environmental performance, cost- and energy efficiency, the need for pre-treatment and preparation of the plastic wastes prior to co-processing, limitations in types and volumes of plastic wastes which can be co-processed, among other factors.

The overall aim is to provide a quantitative and qualitative assessment of how the involvement of private industry

Table 1: indicative data for the five OPTOCE partner countries

Ranking	China	India	Myanmar	Thailand	Vietnam	Total
Population (m)	1386	1325	54	69	96	2929
Population close to waterways (m)	832	> 500	34	48	67	981
Solid waste (SW) generation (Mta)	440	168.4	4.68	27	23	663
Share of plastic waste (PW) in SW (%)	11	8	13	12	12	10
PW generation (Mta)*	48.1	9.5	0.6	3.28	2.8	64
PW generation (tpd)	131,781	25,940	1667	8986	7671	176,045
PW dumped and landfilled (Mta)	32.7	2.5	0.5	1.05	2.24	39
PW incinerated (Mta)**	84.6	1.14	0.003	0.7	0.06	87
PW co-processed (Mta)**	5.5	0.25	0	0.15	0	6
Marine debris – Jambeck et al (Mta)	1.32-3.53	0.09-0.24	0.07-0.19	0.15-0.41	0.28-0.73	1.91-5.10
Cement production (Mta)	2370	337	10	60	96.8	2874
Coal consumption (Mta)	199	56	2	12	19.36	289
Plastic wastes for achieving 10% thermal substitution rate (TSR) (Mta)	56.4	6.7	0.2	1.5	2.4	67
Coal savings at 10% TSR (Mta)	19.9	5.6	0.2	1.2	1.9	29
Reduced CO ₂ -emissions at 10% TSR*** (Mta)	43.8	10.1	0.4	2.6	4.3	61.2

*PW generation data from available government data/reports, World Bank (2016) report and other sources
**Estimated quantity of segregated combustible fraction (SCF)/RDF/Raw MSW (China)- and not pure plastic, utilised in currently operating WtE plants and in cement plants; therefore, the total of PW dumped and landfilled, incinerated and co-processed exceeds PW generation in some cases.
*** Reduced CO₂ emissions is on account of coal savings; emission factor of 95.35 kg CO₂/GJ has been used which is average of the emission factors of sub-bituminous coal and other bituminous coals as per IPCC (2006)

can improve plastic waste management and prevent marine litter in each country.

If local circumstances allow, a comparison between co-processing and 'conventional' treatment technologies like landfilling/dumping and incineration with WtE will be carried out. This will hopefully provide scientific documentation to decision makers to support policy changes.

Regional forum and capacity building

Lessons learned from the pilot demonstrations will be shared through an annual regional multi-stakeholder forum, enabling awareness raising, capacity building and efficient replication across the continent.

The five partner countries are currently at different development stages and will have the possibility to learn from each other's experiences – for example:

- how landfill mining is contributing to remove plastic wastes from dumpsites in Thailand and thereby reduce the future migration to the sea
- how co-processing helps to reduce plastic release from paper production facilities in Vietnam
- how co-processing can contribute to remove plastic wastes from big rivers in China

- how co-processing in the Indian cement industry contributes to solve urgent plastic issues in major Indian cities
- how co-processing can be initiated and developed in Myanmar.

The project aims to assist with increasing the waste treatment capacity and achieving the targets of the Sustainable Development Goals (SDGs) for the selected countries, especially SDG 11.6 and SDG 12.4 on waste management and circular economy, and SDG 14.1 on marine litter reduction.

Relevant and indicative data regarding current plastic waste generation, cement production, co-processing potential, etc is provided in Table 1.

The search for more partners

This project is a pioneering undertaking



and participation is believed to be mutually beneficial for both companies and for the society. Observers and active pilot demonstration plants are welcome to join – this is a unique opportunity to contribute in saving our oceans. Please contact the programme manager for OPTOCE, Chief Scientist Dr Kåre Helge Karstensen on khk@sintef.no ■

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