

# Cement factories can put the brakes on global plastic pollution

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In order to rid the oceans of plastic, we first have to get rid of plastic on land. Cement factories in Asia may be part of the solution. Credit: Unsplash.com

Hope in the midst of crisis. Overflowing landfill sites in Asia may prove to be goldmines for local cement producers. So say researchers at the Norwegian research organization, SINTEF, who have extensive experience with the same concept in China.

Plastic is made from fossil fuels and contains more energy than [coal](#). Substituting industrial coal consumption with non-recyclable [plastic](#) enables us to resolve two problems. The plastic will not end up in landfill or in the sea, and we will reduce levels of coal consumption and thus also CO<sub>2</sub> emissions.

China is now investing heavily in the use of plastic waste as a fuel in the [cement](#) industry, and it was Norwegian researchers that first suggested the idea. The aim of the project OPTOCE (Ocean Plastic Turned into an Opportunity in Circular Economy) is to assist a number of Asian countries to be rid of their landfill sites and at the same time reduce their coal consumption.

## **Half the world's plastic**

China, India, Thailand, Vietnam and Myanmar are together home to three billion people—about half of the world's population. The greater part of the plastic and plastic refuse in the world also originates from these countries. China alone accounts for almost a third of the world's production of plastics.

As well as the plastic they use themselves, these countries also receive large volumes of plastic waste from Europe. Plastic collected in Norway is sent to Germany and that which cannot be recycled—that is, most of it—is often exported onwards to Asia. Unfortunately, this is because only a small proportion of our plastic refuse can be recycled. This may be because it has either already been recycled several times, or because it contains additives that mean it requires more energy to recycle than we

obtain from its re-use. So it ends up as refuse.

## **Drowning in plastic refuse**

The standards of living and levels of consumption in the five Asian countries have increased rapidly in recent years, but the effectiveness of their waste management policies has failed to keep up. They simply cannot get rid of their refuse, which accumulates in great landfill sites. Much of it ends up in the sea, where the plastic can do a great deal of harm.

"When the plastic ultimately ends up as microplastic in the oceans it becomes difficult to remove, so by far the best strategy is to prevent it from entering the marine environment in the first place," says SINTEF's Senior Research Scientist Kåre Helge Karstensen, who is heading the OPTOCE project. The aim of the project is to assist the authorities in these Asian countries to get rid of their landfill sites before the refuse ends up in the oceans.

So where are they going to put all this non-recyclable plastic? Can it be put to any useful purpose? This is where the cement industry enters the stage. The same countries that discharge the greatest volumes of plastic into the oceans also account for two thirds of the world's cement production. Fifty-eight percent of all cement is manufactured in China.

## **A half-billion tons of coal**

Cement is manufactured by heating limestone until it becomes liquid in a process called calcination. This process currently takes place in large furnaces at temperatures of 1,450 degrees Celsius. This requires enormous amounts of fuel, which for the most part is coal. Cement factories across the world are currently burning half a billion tons of coal

every year.

The massive emissions of CO<sub>2</sub> this entails, combined with the calcination process itself, make the industry a serious contributor to climate change. If some of this coal is replaced by non-recyclable plastic we will achieve a two-fold benefit. We will be rid of the landfill sites and at the same time reduce CO<sub>2</sub> emissions.

## **Drastic reductions in coal consumption**

There is nothing new in the idea of using refuse as a fuel in cement production. It was during the oil crisis of 1973 that cement manufacturers in the U.S. started looking for alternative fuel sources. They discovered that refuse could substitute for much of the [fossil fuels](#) they were using.

Norcem's cement factory in Brevik in Porsgrunn started using refuse as a fuel in the 1980s. SINTEF and Kåre Helge Karstensen participated as a research partner in this process right from the start, and ever since, Karstensen, who is a qualified chemist, has been working to bring the concept developed by his group to the global [cement industry](#).

In Europe today, it is standard practice to use refuse as a fuel in the manufacture of cement. The facility at Brevik substitutes 75 percent of what would be coal consumption with refuse. In doing so, it is able to utilize 150,000 tons of waste, including plastic, every year. The aim is eventually to stop using coal altogether.



The landfill site at Nakon Nayok in Thailand contains 42 percent plastic. There are 2,500 such sites in Thailand together containing 190 million tons of accumulated plastic waste. Credit: SINTEF

### **Many years of collaboration**

When in 2018, the Norwegian government delegated the Ministry of Foreign Affairs with the task of establishing a foreign aid program to prevent plastic pollution in the oceans, the Ministry contacted Karstensen at SINTEF.

He had been working with waste management processes in China since

2005 and was the person who introduced the public authorities to the idea of using waste as a source of energy.

"At that time, the concept was entirely unknown in China," says Karstensen. "The authorities were skeptical, but at the same time interested in the concept," he says.

SINTEF took on a facilitation and problem-solving role in an attempt to establish collaboration between local industries and the authorities. Naturally, at first, the industry was unwilling to share commercial secrets with its competitors. However, many years of collaboration have enabled us to establish high levels of trust within the industry, and we have persuaded all parties to participate in the development and sharing of concepts that could be profitable for all concerned.

The utilization of refuse as fuel has become a key aspect of waste management policy in China, and the industry has recognized the economic benefit.

"The country has boosted its waste management capacity and reduced its consumption of coal. The use of refuse as an energy source is thus now one of the key strategies in Chinese waste management policy," says Karstensen.

This is the circular economy in practice. When refuse can be exploited as a resource in industrial processes, the world will need fewer incinerators and landfill sites.

## **Five pilot projects**

The objective of the OPTOCE project is to bring this work forward with a view to removing landfill sites entirely and prevent refuse from ending up in the oceans.

Many countries in Asia are now utilizing refuse as an energy source, although still to a much lesser extent than in Europe. To date, only three percent of coal consumption has been replaced by alternative fuels.

"The potential is enormous," says Karstensen. "However, even if the cement factories of Asia can burn as much as 160 million tons of plastic refuse each year, they will still only be replacing between 10 and 15 percent of their industrial coal consumption," he says.

Much of the work completed to date has been dedicated to persuading the industry and the authorities in these countries to invest in the use of plastic as a fuel.

"Of course we know that this is feasible, so now we intend to show them that it can work in their cement production sectors and that the process is profitable," says Karstensen. "It is crucial that both the industry itself and the authorities recognize the opportunities made available by the use of plastic refuse. We are paying no-one to participate in this project. We now have cement factories in China, India, Thailand, Vietnam and Myanmar taking part in the project. All of them are testing the use of plastic as a fuel. All that remains is to document the environmental and commercial benefits," he says.

## **COVID-19 is causing delays**

The pilot projects were all planned to have been implemented by now, but the cement factories have suspended operations due to the coronavirus outbreak.

"We are in close dialog with the factories and local research institutes and universities," says Karstensen. "I'm sure that the authorities will ensure that production will be resumed as soon as possible. These are maturing economies that have to build hospitals, roads and other major

infrastructure. They will be needing a lot of cement," he says.

## **The pilot projects:**

- One of the biggest cement manufacturers in Thailand is planning to utilize between 100,000 and 250,000 tons of plastic a year as a substitute for coal. Thailand has 2,500 [landfill sites](#) containing 190 million tons of plastic.
- The Yangtze river in China is overflowing with refuse that is causing problems for the turbines at the Three Gorges hydroelectric dam facility. The cement manufacturer in the city of Zigui, located upstream from the dam, is planning to look into the possibility of collecting and processing 100,000 tons of floating waste, including a large volume of plastic.
- Plastic refuse generated by paper manufacturing processes constitutes a major waste problem throughout Asia. Vietnam's largest paper factory, located on the Mekong river, is planning to test the use of plastic refuse as a fuel in a local cement factory.
- Currently, Myanmar operates no plastic waste treatment plants. Together with its environmental authorities and the country's largest waste disposal company, the project is planning experiments in cement factories located outside Mandalay and Yangon to assess the feasibility of the environmentally sound management of plastic refuse. Myanmar does not exploit refuse as a fuel and so stands to obtain even greater benefit from the project. The industrial sector has been the main driver of this initiative because it recognizes the potential profitability.
- India is planning to look into the possibilities of disposing of plastic refuse from the great cities of Agra, Delhi, Goa, Mumbai and Haridwar. A pilot project is being planned to test and compare three different approaches to the disposal of plastic refuse from India's largest landfill site. These will involve (1) the replacement of coal in cement manufacture, (2) the replacement



of coal to fuel a power station and (3) incineration in a local combustion facility.

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