A NEW METHOD FOR TURNING PLASTIC INTO OIL

THE CONVERSION OF MOUNTAINS OF PLASTIC WASTE INTO OIL, and new products, could help address gaps in Japan's recycling efforts.

Despite global concerns over the accumulation of plastic waste, the drive to produce new plastics shows no signs of slowing down. According to OECD data, the world's annual plastic production has doubled in the past two decades, and is set to triple again between 2019 and 2060 due to economic and population growth. Accordingly, plastic waste is on track to triple by 2060.

"The versatile nature of plastic — its light weight, durability and ease of moulding — is hard to rival with any material, now or in the foreseeable future, so plastic is here to stay," says Kenji Asami, a professor at the University of Kitakyushu in Fukuoka, Japan. "But limited fossil fuels and environmental concerns demand a shift in material sourcing and waste management."

In pursuit of this shift, Asami is collaborating with a recycling technology company Environment Energy Co., Ltd., based in Fukuyama in the prefecture of Hiroshima. The company is pioneering a method for converting plastic waste into crude oil using catalysts.

"A core purpose of this technology is to scale the production of high-quality plastic from plastic waste, thereby creating a circular economy in which waste becomes the source of new materials," says CEO, Shuji Noda.

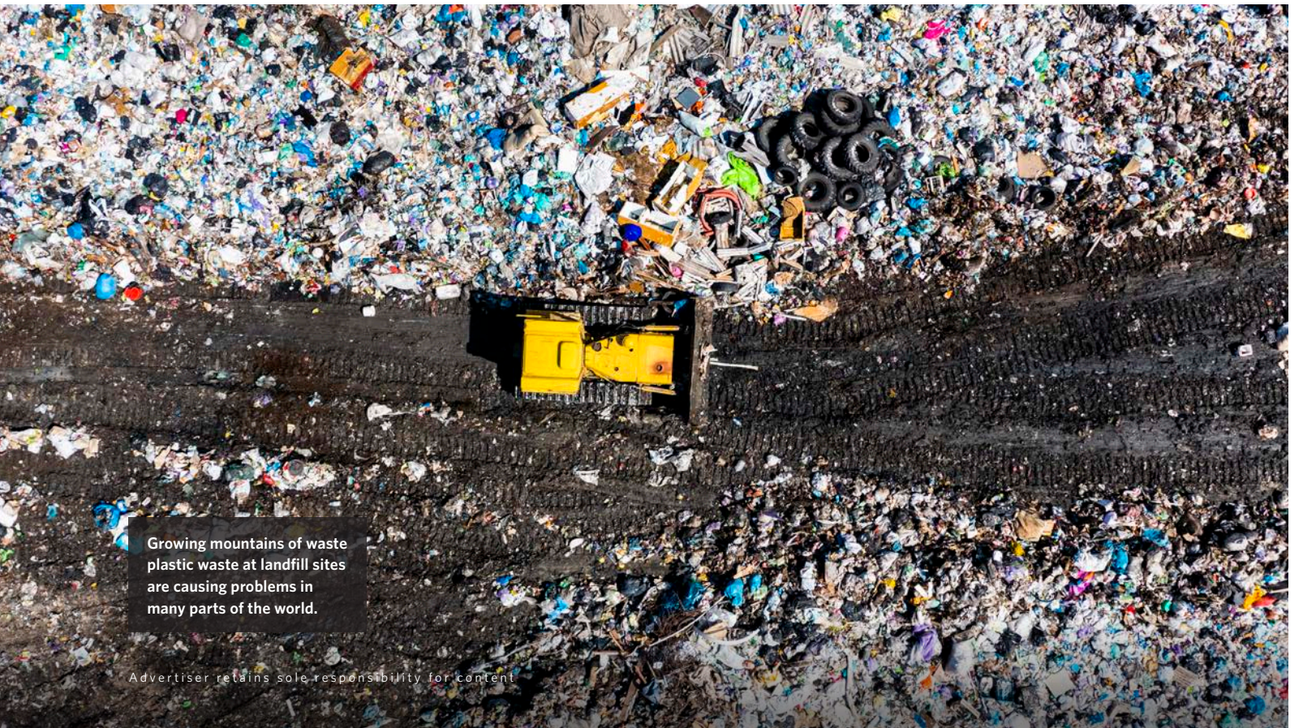
PLASTIC TO OIL

The concept of converting plastic back into crude oil is not new. Past efforts have centred on pyrolysis, a process of applying intense heat in reactors to break down plastic molecules. In the early 2000s, a series of Japanese firms began building plastic-to-oil conversion plants to bring the technology to real-world application. However, due to fires and industrial accidents, and economic problems, these plants were forced to close.

In contrast, Environment Energy Co. aspires to commercialize a method called HiCOP, which uses catalysts already employed in petroleum refining to distil heavy crude oil molecules into lighter molecules, such as gasoline.

The method was developed and patented by Kaoru Fujimoto, a professor emeritus at the University of Tokyo and the University of Kitakyushu; and Xiao-Hong Li, a professor at the University of Kitakyushu.

At 380–450°C, the catalysts — attached to the plastic's surface — break the material into smaller pieces, eventually converting them into hydrocarbon gases. These are then concentrated into crude oil.



Growing mountains of waste plastic waste at landfill sites are causing problems in many parts of the world.

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▲ The novel method devised by Environment Energy Co. turns waste plastic into oil, which can be used once more to create 'virgin' plastic.

As HiCOP yields crude oil that is abundant in gasoline and diesel, Asami initially expected the derivatives to be used as fuel. Possible uses might include transportation, boilers, powering heavy machines for construction, and providing energy in remote islands and mountain ranges. However, experts agree that the world must transition rapidly from the use of fossil fuels to limit global warming to 1.5°C above pre-industrial levels, so another use for the oil from recycled plastic needs to be found moving forwards.

"Increasing attention on recycling has amplified the need for converting plastic into oil for the purposes of obtaining raw materials for new plastic," says Asami, and HiCOP's oil also contains abundant naphtha, which is a raw ingredient for plastic.

The researchers argue that chemical recycling, in which waste plastics are returned to the same high quality as so-called virgin plastics, will become the mainstay of recycling in the future.

On obtaining a Japanese patent licence, Noda optimized the method and created a commercially viable machine that could perform the entire process. Key to success was achieving stable, long-term, continuous operation, which was difficult with pyrolysis, as the plastic waste was processed into batches.

Furthermore, oil produced using the HiCOP method has reduced wax content, enhancing its fluidity. This is particularly advantageous during winter, mitigating previous issues associated with petroleum solidification in storage tanks.

RECYCLING GAPS

Noda hopes plastic-to-oil conversion will fill a gap in the recycling landscape, both in Japan and overseas.

Currently, mechanical recycling — in which plastic is physically recycled through sorting, washing and grinding — is the dominant method, accounting for 21% of Japan's plastic waste processing. This approach requires plastic waste to be clean, and yields lower quality products with a strong odour and unattractive colours.

On the other hand, chemical recycling — which converts plastic into raw materials through chemical reactions — currently only accounts for 4% of Japan's plastic waste processing. Noda considers this area a crucial opportunity for increasing the amount of plastic recycled in Japan, and believes that HiCOP, which is considered a type of chemical recycling, has the potential to take on the bulk of the growth.

The strength of this method, he says, "lies in its versatility — HiCOP allows for long-term, continuous processing of dirty plastic waste and a mixture of different types of plastics."

LOOKING AHEAD

"The benefits of HiCOP will be particularly evident for recycling consumer-derived plastic," such as food packaging, says Noda. "These are typically more heavily contaminated and thus harder to recycle than plastic waste arising from industry. Many are also laminated plastics, which layer various materials and plastics atop one another."

The company plans to begin commercial operation in 2025. They have partnered with a Japanese petroleum company to refine the crude oil produced from plastics. As a first step, they aim to convert 20,000 metric tonnes of plastic waste into crude oil annually.

"Petroleum is arguably the only raw ingredient that can generate new, transparent plastic that consumers find desirable for use in commodities like food and beverage packaging. But plastic generated from methods like HiCOP can partly satisfy that demand," says Noda. "Combining this with new biodegradable resins like plant-based plastic would help us move towards a sustainable circulation of plastic, and away from fossil fuel extraction." ■

Environment Energy

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CONSUMER PERCEPTION

RECYCLING SUCCESS depends on pricing.

Environment Energy's CEO Shuji Noda believes that recycling effort success depends not only on technology, but on social frameworks that nudge manufacturers and consumers to pay for recycled plastic. For example, the OECD recommends taxes on new plastic, to make the relative price of recycled plastics seem more attractive.

He also argues that consumers should raise their own awareness. "We need to select environmentally friendly products even if they are more expensive, and we need to purchase products that incorporate the costs of recycling," says Noda.

In any case, "frameworks for recycling should include a system that financially enrich the people involved in the collection and disposal of plastic waste," he adds. "The price of plastic in the future should also cover the cost of collecting marine plastics that wash up on beaches and also fund welfare activities that assist people living among plastic litter in landfills."

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