



BETTER RECYCLING FOR COMPLEX PLASTIC PRODUCTS

Tackling challenging composite materials will help meaningfully expand **RECYCLING INDUSTRIES**.

Since China's 2018 ban on the import of most plastic waste for recycling, Japan has faced a major challenge. Prior to the ban, the country was shipping nearly half of its roughly 1.5 million tonnes of plastic waste annually to China and Hong Kong.

Japan remains one of the world's top exporters of waste plastics, and is now redirecting them to countries including Malaysia, Vietnam and Indonesia. But in 2019, Japan adopted the 'Resource Circulation Strategy for Plastics', a framework that aims to make the nation a leader in plastic resource recycling

▲ Recycled fibre optic plastic produced by standard crushers still features unmixed core wires.

and circulation by 2030.

Since then there has been an active push to accelerate innovation in recycling technologies, as well as to build domestic recycling capacity — something that will only speed up now that a substantial reduction of waste globally falls under the United Nation's Sustainable Development Goals.

COMPOSITE ISSUES

Takashi Mugiya, CEO of recycling systems company MSC Co., Ltd, based in Sendai, says that tackling challenging materials would meaningfully carry the recycling industry forward. In Japan, the current annual production and consumption of plastic is roughly 10.45 million tonnes. Out of this, only 1.77

million tonnes can be recycled into commercial materials.

"And much of this end up discarded within recycling plants, resulting in only 330,000 tonnes worth of plastics returning to the market," explains Mugiya. "Researching and commercializing practical machinery that enables the recycling of tricky materials is important to fundamentally reducing the waste plastics that are incinerated or sent to landfills."

Plastic materials that are challenging to recycling include everyday composite materials that contain resins, or those that include metals and other additives. Examples range from food packaging, such as potato chip bags — which combine

plastic and vapour-deposited aluminium in order to maintain freshness — to electrical cables — which combine metals and a type of resin that hardens when heated.

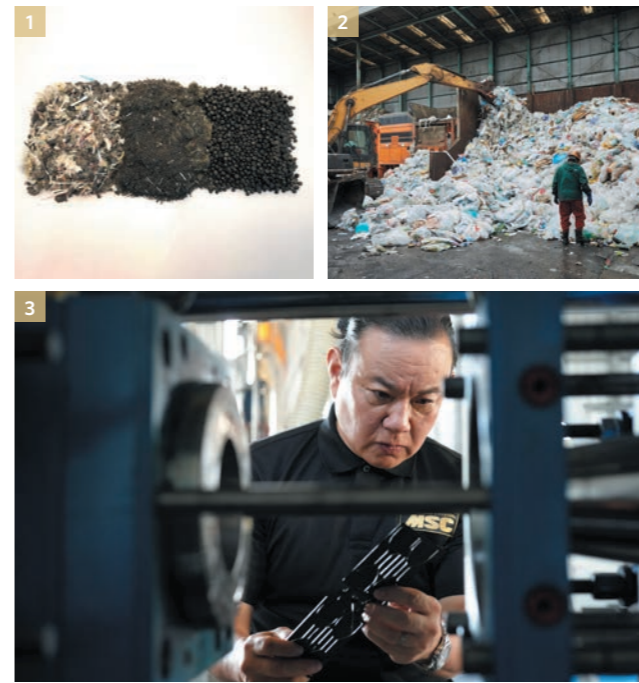
MSC has had past success with recycling electrical cables, leading to technology with a pending patent. Now, in a project commissioned by Japan's Ministry of Environment, Mugiya aspires to establish similar success with fibre optic cables.

"Success with recycling fibre optics could be a role model that facilitates more recycling of challenging materials," Mugiya argues.

FIBRE OPTICS SOLUTIONS

Fibre optics are composed of a core, typically made of ultra-

Makiko Tanigawa/DigitalVision/Getty



- ▲ 1. Three samples produced by different crushers and extruders used for recycling optical fibre into plastic.
2. Japan is one of the world's biggest producers of plastic waste after the United States.
3. Takashi Mugiya is CEO of recycling systems company MSC, a company that is creating advanced recycling resources in Japan.

pure silica glass, enveloped by a layer of another type of glass or plastic. These materials are key to transmitting data quickly over long distances, but present significant challenges for recycling. The fibres themselves are extremely thin, often roughly only 125 micrometers in diameter, making material separation difficult.

Moreover, the fibres also contain metals and other polymers. Together, these factors contribute to a complex, cost-intensive recycling process, with about half of the 9,000 tonnes of fibre optic being buried or incinerated annually.

In the past, larger corporations have attempted to recycle fibre optics by first separating the resin and glass fibres, says Mugiya. But, though technically possible, the volume of material recovered was

minuscule compared to the effort needed for processing.

MSC is therefore pioneering a method that bypasses the separation by grinding the resin and glass fibre into a fine powder. This allows them to later be melted and kneaded by machines into high-quality recycled plastic.

Key to this project is MSC's improvement of pulverizers used for turning waste plastics into powdery particles with a diameter of 100–300 microns. "With conventional pulverizers, the recycled plastic would either melt or harden due to increasing mechanical temperatures," explains Mugiya. "In the improved pulverizer, we modified the blade shape and cooling mechanism so that resins do not melt when pulverized. We then developed a mass production facility."

TRAINING PROGRAMMES FOR RECYCLING SPECIALISTS

Recycling systems company, MSC, launched an immersive educational system in 2022, offering a blend of theoretical instruction, supported by textbooks created by MSC, and hands-on training using the machinery commonplace in recycling facilities. The curriculum delves deep into the technical knowledge and skills essential for engineers operating the machinery: resin characteristics, machine mechanics, electrical components, safety protocols, work efficiency, maintenance requirements, the importance of life-cycle assessments, and how to save on power consumption.

Plans are also underway to establish a certification system. Takashi Mugiya, CEO of MSC, hopes that this contributes to elevating the standards of the recycling industry in Japan. "Structured certification tiers offer learners clarity on foundational and advanced topics. It's a chance to reposition recycling as a specialized field, demanding expert knowledge," he says.

Social awareness is another priority. Mugiya is a vocal advocate, and his initiatives have included the production of a film underlining the urgency of refining recycling techniques to tackle environmental challenges. Mugiya sees these educational endeavors and his environmental activism — such as collaborating with beach cleanup groups — as mutually reinforcing.

"Merely collecting trash isn't the end," he says. "We must address what comes after — especially the issues of incineration and landfilling. To make a tangible difference, the public must grasp the significance of enhancing waste treatment processes."

In particular the modified cooling mechanism shows promise for slashing costs, substituting out expensive liquid nitrogen cooling methods. This is expected to reduce to about a 50th of the cost of using a commercially available heat exchanger.

But for the industry to progress, fostering further partnerships with resin experts and welcoming new industry players is essential, says Mugiya.

FOSTERING EXPERTISE

Mugiya also emphasizes the importance of building machine operator expertise for innovative recycling techniques to be successful.

"Recycling companies in Japan have largely focused on collecting and sorting, rather than on complex material or chemical recycling. This is

partially because the market for recycled plastics wasn't lucrative," he says. "With little incentive to produce large quantities of recycled plastics, machine operators could get by without foundational knowledge in resins or their properties dirtiness. Given the rising demand for domestic recycling, it's crucial for operators to understand these principles."

Now, large companies may need to train specialized teams, says Mugiya (see box). "Small and medium-sized enterprises — responsible for the bulk of Japan's recycling — will need to cultivate teams with a broad skillset." ■

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