NEWS RELEASE

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NTU Singapore scientists develop cleaner way to recycle mixed plastic packaging

Scientists from **Nanyang Technological University, Singapore (NTU Singapore)** have developed a new method to recycle mixed plastic packaging without using harmful chemical solvents – an approach that could make one of the world's most difficult waste streams significantly easier to handle.

The research team from NTU Singapore's **School of Materials Science and Engineering and Nanyang Environment and Water Research Institute (NEWRI)** has introduced a process called depolymerisation-induced polymer separation, or **DIPS**. The method selectively breaks down one type of plastic in mixed plastic packaging while leaving the other plastics intact, allowing each material to be recovered and reused.

Addressing a global recycling challenge

Mixed plastic packaging, commonly used to wrap snacks, instant noodles and other food products, is designed to be tough and airtight. The packaging is made up of several different plastics bonded tightly together, making it challenging to recycle. Even if recycled, the material is often of low quality and has little commercial value.

As a result, most multilayer packaging ends up in landfills or incinerators, adding to a fast-growing waste burden. Global plastic production is projected to reach 736 million tonnes[1] by 2040.

Lead investigator Professor Hu Xiao, who is also **the Programme Director for Sustainable Chemistry and Materials at NEWRI**, said: “We’re seeing more mixed plastic packaging used in everyday food products, but recycling it safely and efficiently is still a major challenge. Our team set out to tackle this by developing a practical, scalable way to separate these materials without using harmful solvents."

[1] OECD Policy Scenarios for Eliminating Plastic Pollution by 2040; OECD, 2024.

Study co-author Dr Liang Yen Nan, who is also **Senior Research Fellow, NEWRI**, said: “One of the biggest hurdles in plastic recycling today is the lack of a viable way to deal with mixed plastics. This project was driven by that challenge, and our goal is to help move the industry closer to a solution that works in the real world.”

A solvent-free, continuous process

The DIPS method uses a technique called reactive extrusion, a solvent-free, continuous industrial process in which an extruder machine – a device commonly used in manufacturing to melt and shape plastics – doubles as a chemical reactor.

During processing of mixed plastic packaging, **poly(ethylene terephthalate) (PET)** – the plastic commonly used for drink bottles – reacts with glycerol, a cheap and widely available reagent, and is selectively broken down into smaller molecules. This PET-derived material has a different physical and chemical nature from the original plastic, causing it to naturally separate from **polypropylene (PP)**, another common plastic used in packaging.

The separation happens automatically during processing, driven by differences in the materials' polarity (a feature that determines solubility) and viscosity (a material’s resistance to deformation under force).

The entire process runs at room pressure and without any solvents, making it safer and potentially more cost-effective than conventional chemical recycling approaches.

High-quality recycled materials

In laboratory tests, the recovered PP retained mechanical properties close to those of virgin plastic, achieving up to **90 per cent** of its original tensile strength (maximum stress a material can sustain before it breaks) under optimal conditions – meaning the recycled material is strong enough for practical reuse.

Using samples from post-industrial mixed packaging waste, the method successfully separated the plastic components and produced significantly better material quality compared to conventional mechanical recycling approaches.

While the recovered PET cannot be directly reused, it contains chemical groups that make it potentially useful for higher-value applications such as specialty materials to replace epoxy used in wind turbine blades or for conversion into a monomer (building block of a polymer).

The researchers believe the DIPS approach can be extended to other mixed plastic combinations and scaled up using commonly used industrial extrusion equipment.

First author Kathirvel Periasamy, a PhD student and Provost Graduate Awardee under NTU's flagship Interdisciplinary Graduate Programme, said: "Our process attempts to bridge the gap between laboratory research and industrial application. By simplifying separation and eliminating solvents, we aim to make plastic recycling more economically viable and environmentally sustainable."

If mixed plastic waste were efficiently recycled at scale, it could unlock an economic value estimated at more than US$250 billion annually[2].

As a next step, the research team plans to collaborate with industry partners to validate the approach under scaled-up conditions and welcomes interest from potential collaborators.

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Note to editor:
Paper titled: "Depolymerization Induced Polymer Separation: A New Strategy for Continuous and Efficient Separation of PP/PET Multilayer Plastic Packaging Waste", published in Industrial & Engineering Chemistry Research, March 16, 2026 https://pubs.acs.org/doi/10.1021/acs.iecr.6c00174

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About Nanyang Technological University, Singapore

Nanyang Technological University, Singapore (NTU Singapore) is a premier technological university that develops leaders and creates societal impact through education, research, and service.

[2] OECD Global Material Resources Outlook to 2060: Economic Drivers and Environmental Consequences; OECD, 2019.

Ranked amongst the world's top universities, NTU has 40,000 undergraduate and postgraduate students in the Business, Computing & Data Science, Engineering, Humanities, Arts, & Social Sciences, Medicine, Science, and Graduate colleges.

NTU is also home to world-renowned autonomous institutes – the National Institute of Education and S. Rajaratnam School of International Studies – and various leading research centres such as the Earth Observatory of Singapore, Nanyang Environment & Water Research Institute, Energy Research Institute at NTU, and Singapore Centre for Environmental Life Sciences Engineering.

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