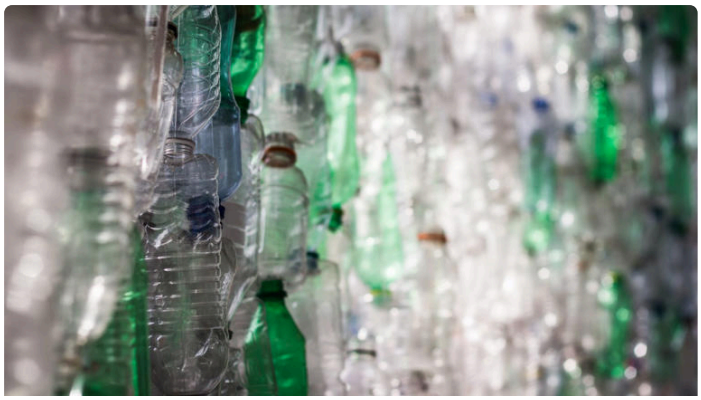
NTU Singapore develops solvent-free process to recycle multilayer plastic packaging

Story by Kaif Shaikh • 2d • 3 min read



NTU Singapore develops solvent-free process to recycle multilayer plastic packaging

Scientists in Singapore have developed a new recycling technique that could make it easier to recover valuable materials from one of the world's most difficult waste streams. Multilayer plastic packaging.

Researchers from Nanyang Technological University (NTU) Singapore and the Nanyang Environment and Water Research Institute (NEWRI) say their approach can separate mixed plastics without using the harsh chemical solvents commonly associated with advanced recycling technologies.

The method could provide a more environmentally friendly route for processing packaging used in products such as snack foods, instant noodles, and other consumer goods. The findings come as plastic waste continues to grow worldwide.

According to The OECD (Organization for Economic Co-operation and Development), global plastic production could reach 736 million tonnes annually by 2040, increasing pressure on recycling systems already struggling to handle complex packaging materials.

Why mixed plastic packaging is difficult to recycle

Many modern food packages are made from multiple layers of different plastics bonded together. Manufacturers use these combinations because they create strong, lightweight packaging that protects food from moisture, oxygen, and contamination. However, those same characteristics make recycling extremely challenging.

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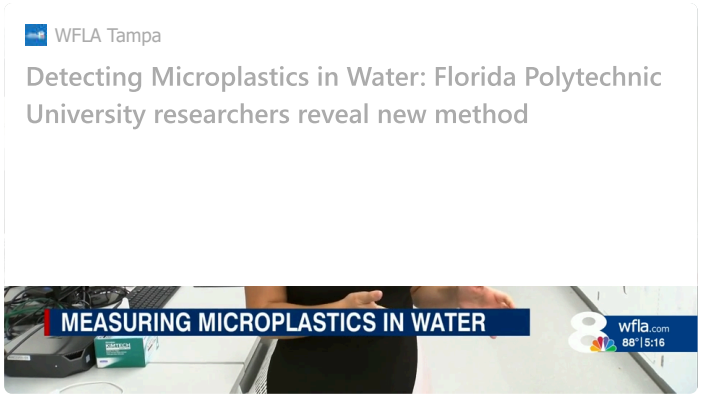

Conventional mechanical recycling works best when dealing with a single plastic type. When different plastics are mixed together, the resulting recycled material often suffers from reduced quality and limited commercial value. As a result, large amounts of multilayer packaging end up being landfilled or incinerated rather than recycled.

To address this problem, the NTU team developed a process known as depolymerization-induced polymer separation, or DIPS. According to the researchers, the technique selectively breaks down one plastic while leaving another intact, allowing the materials to separate naturally during processing.

How the process works

The system relies on a manufacturing technique called reactive extrusion, in which equipment commonly used to melt and shape plastics also functions as a chemical reactor. In the team's experiments, mixed plastic waste containing polyethylene terephthalate (PET) and polypropylene (PP) was processed together. PET, widely used in beverage bottles and food packaging, reacts with glycerol, a low-cost and widely available chemical, to break down into smaller molecules.

Once altered, the PET no longer behaves like the original plastic. Differences in properties such as polarity and viscosity cause the materials to separate automatically during processing.

Unlike many chemical recycling approaches, the process operates without solvents and at normal atmospheric pressure, potentially reducing costs, safety concerns, and environmental impacts. Professor Hu Xiao, the study's lead investigator and Program Director for Sustainable Chemistry and Materials at NEWRI, said the team wanted to develop a practical method for addressing the growing challenge of mixed plastic waste.

"We're seeing more mixed plastic packaging used in everyday food products, but recycling it safely and efficiently is still a major challenge," Hu said.

Producing higher-quality recycled plastics

Laboratory testing showed promising results. The recovered polypropylene retained up to 90 percent of the tensile strength of virgin plastic under optimal conditions, suggesting it could be reused in practical applications rather than downcycled into lower-value products.

The researchers also tested the process using post-industrial mixed packaging waste and reported significantly improved material quality compared with conventional mechanical recycling techniques.

While the recovered PET cannot be immediately returned to its original form, it may still hold substantial value. The researchers note that it could potentially be used in specialty materials or converted into chemical building blocks for future manufacturing applications.

Potential for large-scale deployment

One of the most attractive aspects of the technology is that it can be implemented using equipment already widely used across the plastics industry. Because reactive extrusion is an established industrial process, the researchers believe the DIPS approach could be scaled up without requiring entirely new manufacturing infrastructure.

The team also believes the concept could be adapted to other combinations of mixed plastics, potentially expanding its usefulness beyond food packaging.

According to estimates cited by the researchers, successfully recycling mixed plastic waste at scale could unlock more than $250 billion in economic value annually while reducing the environmental burden created by discarded packaging.

The next phase of the project will focus on working with industry

conditions and assess its commercial viability.