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Scientists break down plastic waste using air

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Scientists have developed a new method to break down plastic waste using moisture from the air. By exposing a common type of plastic to an inexpensive catalyst and leaving it exposed to ambient air, researchers broke down 94 per cent of the material in just four hours. The plastic transformed into terephthalic acid (TPA), a highly valuable building block for polyesters. Because TPA can be upcycled into more valuable materials, the process offers a safer and cheaper alternative to current plastic recycling methods.

"The US is the number-one plastic polluter per capita, and we only recycle five per cent of those plastics," said Yosi Kratish, a research assistant professor of chemistry at Northwestern University. "What's particularly exciting about our research is that we harnessed moisture from the air to break down the plastics, achieving an exceptionally clean and selective process. By recovering the monomers, which are the basic building blocks of PET [polyethylene terephthalate], we can recycle or even upcycle them into more valuable materials."

Plastic waste is an increasingly important issue. Over half of the plastic ever made has been produced since 2000, and annual production is projected to double by 2050, according to the European Environment Agency. To date, only nine per cent of the plastics ever produced have been recycled. The remainder, with lifetimes often lasting generations, can have serious environmental and health impacts. For example, they wash out to sea to form floating blobs of trash, harm wildlife and break down into microplastics that can enter the human brain and other parts of our bodies.



Every day, around 8 million pieces of plastic find their way into the ocean

Did you know?

It can take 500 years for plastic waste to degrade

To find a new method to break down some of this waste, the researchers applied a molybdenum catalyst – a silver, ductile metal – and activated carbon to PET, the most common type of polyester plastic. The researchers then heated the mixture. After a short time, this broke the polyethylene's chemical bonds. Then, when the team exposed the material to air, the mixture transformed into TPA, a valuable polyester precursor, and acetaldehyde, an industrial chemical that is also valuable and is easy to lift from the mixture.

When they tested the method on mixed plastics, the researchers found that it had an effect only on the polyester materials. That meant they didn't have to presort the plastics. It worked on plastic bottles, T-shirts and coloured plastics, breaking them down into pure, colourless TPA. "It worked perfectly," Kratish said. "When we added extra water, it stopped working because it was too much water. It's a fine balance. But it turns out the amount of water in the air was just the right amount."

The team's next steps will be to adapt the process to large-scale industrial applications. "Our technology has the potential to significantly reduce plastic pollution, lower the environmental footprint of plastics and contribute to a circular economy where materials are reused rather than discarded," study author Naveen Malik, who was a researcher at Northwestern University at the time, said in a statement. "It's a tangible step towards a cleaner, greener future, and it demonstrates how innovative chemistry can address global challenges in a way that aligns with nature."