

Title: Revolutionary Enzyme Transforms Plastic Recycling, Paving the Way for a Circular Plastic Economy

Subtitle: Developed by scientists using machine learning, this groundbreaking enzyme has the potential to change the recycling industry and significantly reduce plastic waste.

Lede / Opener

Researchers have made a groundbreaking discovery in the fight against plastic pollution by developing an innovative enzyme capable of breaking down common plastic materials in just one week. This enzyme not only outperforms its natural and engineered counterparts in breaking down polyethylene terephthalate (PET) plastics, but also demonstrates the potential for a closed-loop recycling process that could revolutionize the way we manage plastic waste.

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"The possibilities are endless across industries to leverage this leading-edge recycling process," said Hal Alper, professor in the McKetta Department of Chemical Engineering at UT Austin. "Beyond the obvious waste management industry, this also provides corporations from every sector the opportunity to take a lead in recycling their products. Through these more sustainable enzyme approaches, we can begin to envision a true circular plastics economy."

History / Background

Historically, enzymatic depolymerization of PET plastics, first reported in 2005, has been limited by the enzymes' need for high reaction temperatures and highly processed substrates. Most of the 19 PET-hydrolysing enzymes (PHEs) identified to date have shown poor activity at moderate temperatures and neutral pH levels, which hampers their potential for in situ or microbially enabled degradation solutions for PET waste.

Back to paper. Why this is better

Researchers at the Cockrell School of Engineering and College of Natural Sciences used a machine learning model to generate novel mutations to a natural enzyme called PETase that allows bacteria to degrade PET plastics. The model predicts which mutations in these enzymes **would accomplish** the goal of quickly depolymerizing post-consumer waste plastic at low temperatures.

Through this process, the researchers **proved the effectiveness** of the enzyme, which they are calling FAST-PETase (functional, active, stable, and tolerant PETase). "This work really demonstrates the power of bringing together different disciplines, from synthetic biology to chemical engineering to artificial intelligence," said Andrew Ellington, professor in the **Center for Systems and Synthetic Biology** whose team led the development of the machine learning model.

More background.

Recycling is the most obvious way to cut down on plastic waste. However, globally, less than 10% of all plastic has been recycled. FAST-PETase has the potential to supercharge recycling on a large scale, allowing major industries to reduce their environmental impact by recovering and reusing plastics at the molecular level.

The enzyme was able to complete a "circular process" of breaking down the plastic into smaller parts (depolymerization) and then chemically putting it back together (repolymerization). In some cases, these plastics can be fully broken down to monomers in as little as 24 hours.

Biological solutions, like this enzyme, take much less energy than other methods. Research on enzymes for plastic recycling has advanced during the past 15 years, but until now, no one had been able to figure out how to make enzymes that could operate efficiently at low temperatures to make them both portable and affordable **at large industrial scale**. FAST-PETase can perform **the process** at less than 50 degrees Celsius.

What process?

End with future-facing ideas

Up next, the team plans to work on scaling up enzyme production to prepare for industrial and environmental **application**. "When considering environmental cleanup applications, you need an enzyme that can work in the environment at ambient temperature. This requirement is where our tech has a huge advantage in the future," Alper said.

This **groundbreaking** enzyme highlights the power of cutting-edge machine learning in creating **eco-friendly** solutions for our plastic-filled world, taking us one step closer to a truly circular plastic economy.