

# Technology Snapshot



## PAD-TIE: Platform to Accelerate Discovery of Tailored Industrial Enzymes

Advancing Enzymatic Plastic Degradation and Upcycling

### Applications

Enables the discovery and optimization of enzymes that can break down plastic polymers, supporting more efficient and selective enzymatic recycling processes for a range of plastic types.

### Partnership Opportunities

PAD-TIE – LANL seeks an industry partner to enter into a collaborative partnership or license agreement to further product development of these industrially relevant enzymes with the intent to supply these engineered enzymes in targeted industries.

### Technology Readiness Level 6

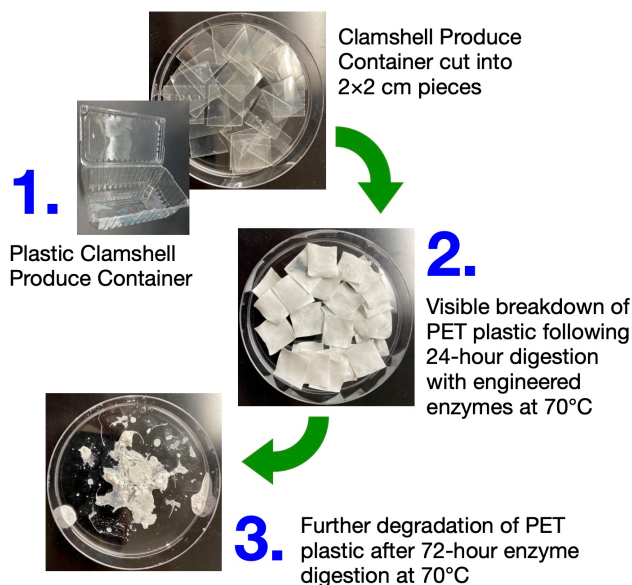
LANL's PET-ase technology has been demonstrated at the laboratory scale and is ready for commercial development, including scale-up and integration into bioreactor systems.

### IP Information

Three U.S. patents pending.

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**Fig. 1.** PET clamshell samples subjected to enzymatic digestion at 70°C for 0, 24, and 72 hours. Breakdown progression indicates thermostable PETase activity optimized through the PAD-TIE platform.

### Overview

Los Alamos National Laboratory's PAD-TIE platform is an advanced screening system designed to accelerate the discovery and optimization of enzymes that break down polyethylene terephthalate (PET), one of the most widely used plastics. Traditional enzyme development is slow and requires testing individual enzymes under controlled conditions. PAD-TIE overcomes this limitation by simultaneously screening tens of thousands of enzyme variants under industrially relevant conditions for PET degradation.

Unlike conventional methods, PAD-TIE evaluates enzyme efficiency, stability, and production potential in a single process, ensuring that only the most viable candidates move forward.

Validated in lab-scale bioreactors that replicate industrial recycling environments, PAD-TIE supports sustainable PET recycling and upcycling, breaking plastic down into its fundamental building blocks (monomers) for reuse: without the need for harsh chemicals or energy-intensive processes.

## Advantages

- **Scalable High-Throughput Screening:** Evaluates tens of thousands of enzyme variants simultaneously, accelerating discovery.
- **Optimized for Industrial Use:** Operates at the optimal temperature for enzymatic PET degradation and high plastic processing efficiency, ensuring compatibility with existing recycling infrastructure.
- **Efficient Resource Use:** Uses widely available reagents and eliminates enzyme purification in early screening, reducing material and labor costs.
- **Comprehensive Performance Assessment:** Simultaneously measures enzyme activity, stability, and production efficiency, reducing failure rates.
- **Adaptable to Industry Needs:** Can be optimized for various processing conditions, different PET compositions, and additives in plastic waste.

## Technology Description

PAD-TIE is a laboratory platform developed at Los Alamos National Laboratory for the rapid discovery and optimization of enzymes that degrade polyethylene terephthalate (PET), a common plastic used in consumer packaging. The platform can accelerate enzyme development for PET breakdown by combining directed evolution, controlled genetic variation and selection, with a high-efficiency Petri dish-based screening system to rapidly identify top-performing candidates. This is done by evaluating large enzyme libraries under industrially relevant conditions where PET degradation is most effective.

Optimized enzymes identified through this platform can break down PET into its monomers, that can be reused to create new materials, supporting more sustainable recycling processes without relying on harsh chemicals or high energy input.

## Market Application

PAD-TIE is designed for industry partners seeking scalable, enzyme-based solutions for plastic waste management and recycling, including:

- **Recycling and Waste Management:** Enhances PET recycling by breaking plastic down into reusable monomers.
- **Bioremediation and Environmental:** Supports plastic degradation in marine environments, landfills, and polluted sites.
- **Polymer Manufacturers:** Enables the integration of engineered enzymes into industrial plastic processing workflows.
- **Circular Polymer Feedstocks:** Recovers PET monomers (terephthalic acid and ethylene glycol) from post-consumer waste for re-polymerization into food-grade or fiber-grade PET, supporting closed-loop plastics manufacturing.

## Next Steps

Building on PAD-TIE's capability to screen large enzyme libraries and validate candidates in small bioreactors at the laboratory scale, the next step is to identify partners interested in leveraging the platform for industrial applications, enzyme development, or sustainable recycling solutions.

- **Test Performance:** Testing the enzymes in larger bioreactors using post-consumer PET waste.
- **Commercial Workflows:** Partnering to integrate PAD-TIE into commercial recycling workflows
- **Optimize Enzymes:** Adapting the platform to optimize enzymes beyond PET degradation for additional plastic waste challenges.