Enhancing the Mechanical Recycling of Food Packaging
Exploring Potential Solutions through Enzymes

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Contact Info

Introduction

The process of mechanical recycling for food packaging is inhibited by numerous factors throughout the entire process. Challenges arise from sorting of the plastic waste as well as contamination of the waste stream from other polymers, food and non-intentionally added substances [1].

Goal

To identify and explore the potential use for enzymes within the mechanical recycling of plastic food packaging to obtain good quality recycled material.

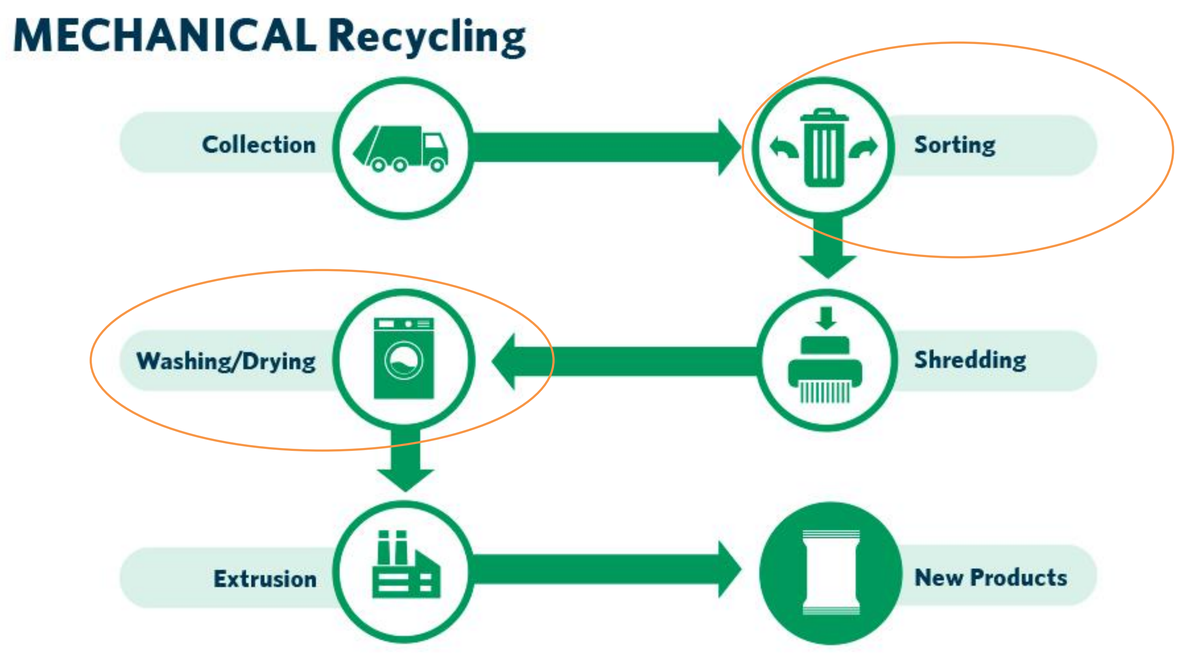

Figure 1: General process of mechanical recycling [2]

Technical challenges

- Enzymes exhibit high specificity, restricting the range of materials suitable for their action
- Technological readiness is low
- Process is relatively slow when compared to other recycling methods

References

[1] A. S. Bauer, M. Tacker, I. Uysal-Unalan, R. M. S. Cruz, T. Varzakas, and V. Krauter, “Recyclability and redesign challenges in multilayer flexible food packaging—a review,” Nov. 01, 2021, *MDPI*. doi: 10.3390/foods10112702.
[2] Amcor, "Chemical recycling for flexible packaging," [Online]. Available: https://www.amcor.com/insights/blogs/chemical-recycling-flexible-plastic-packaging. [Accessed: 31-Mar-2025].
{3] ESTECO, "Simulation in plastic waste recycling," [Online]. Available: https://engineering.esteco.com/blog/simulation-plastic-waste-recycling/. [Accessed: 31-Mar-2025].

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Sorting

Enzymes used as separation tools

Breakdown of a targeted polymer, within a mixture of polymers used in food packaging.

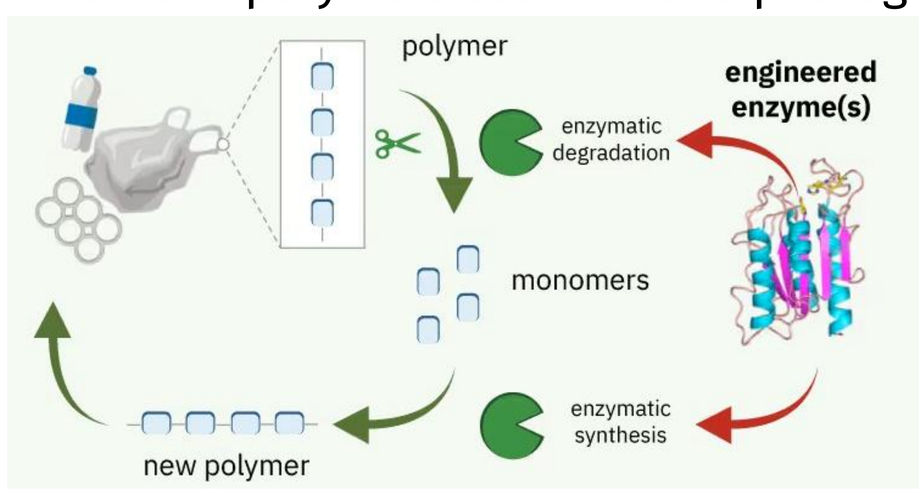

Figure 2: General process of enzymatic recycling, targeted polymer will be broken down into monomers and separated [3].

Washing

Enzymes can be used as cleaning tools

Use of enzymes to breakdown of foreign substances such as food waste, additives such as adhesives and non-intentionally added substances.

Inks | Adhesives | Non- Intentionally Added Substances

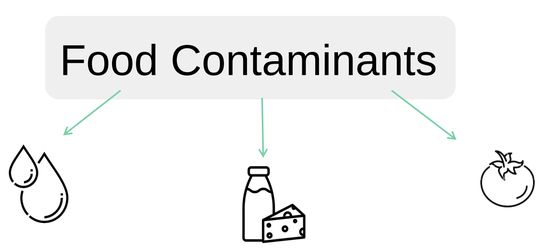

Figure 3: Contaminants present within the washing step of recycling

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