# Using microbes for sustainable plastic production and biodegradation

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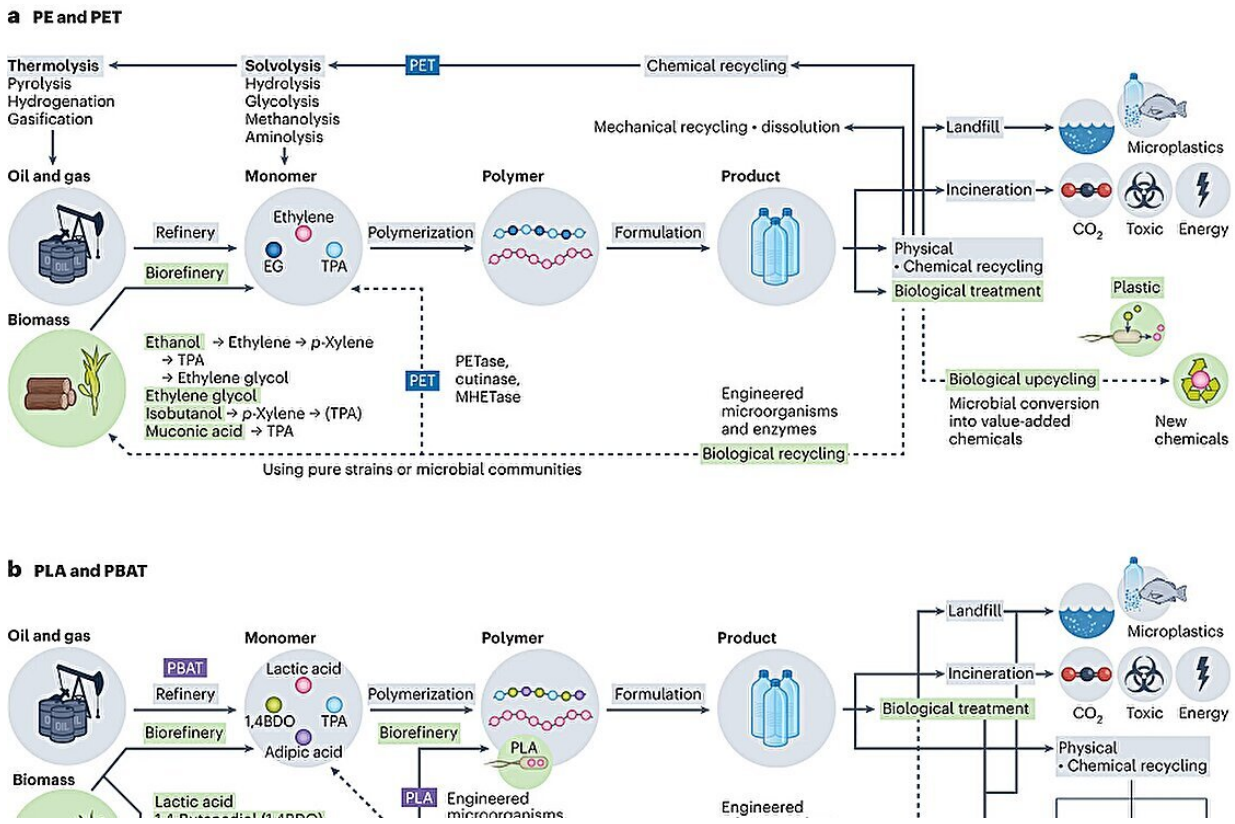


Life cycle of plastics produced using microbial biotechnologies. Credit: *Nature Microbiology* (2023). DOI: 10.1038/s41564-023-01529-1

Plastic is one of the important materials in modern society, with approximately 460 million tons produced annually and with expected production reaching approximately 1.23 billion tons in 2060. However,

since 1950, plastic waste totaling more than 6.3 billion tons has been generated, and it is believed that more than 140 million tons of plastic waste has accumulated in the aquatic environment.

Recently, the seriousness of microplastic pollution has emerged, not only posing a risk to the marine ecosystem and human health, but also worsening global warming by inhibiting the activity of marine plankton, which play an important role in lowering the Earth's carbon dioxide concentration.

A research team led by Distinguished Professor Sang Yup Lee of the Department of Chemical and Biomolecular Engineering has published a paper titled "Sustainable production and degradation of plastics using microbes" in *Nature Microbiology* that covers the latest technologies for producing plastics and processing waste plastics in an eco-friendly manner using microorganisms.

As the international community moves to solve this plastic problem, various efforts are being made, including 175 countries participating to conclude a legally binding agreement with the goal of ending plastic pollution by 2024. Various technologies are being developed for sustainable plastic production and processing, and among them, biotechnology using microorganisms is attracting attention.

Microorganisms have the ability to naturally produce or decompose certain compounds, and this ability is maximized through biotechnologies such as metabolic engineering and enzyme engineering to produce plastics from renewable biomass resources instead of fossil raw materials and to decompose waste plastics.

Accordingly, the research team comprehensively analyzed the latest microorganism-based technologies for the sustainable production and decomposition of plastics and presented how they actually contribute to

solving the plastic problem. Based on this, they presented limitations, prospects, and research directions of the technologies for achieving a circular economy for plastics.

Microorganism-based technologies for various plastics range from widely used synthetic plastics such as polyethylene (PE) to promising bioplastics such as natural polymers derived from microorganisms (polyhydroxyalkanoate (PHA)) that are completely biodegradable in the natural environment and do not pose a risk of microplastic generation. Commercialization statuses and latest technologies were also discussed.

In addition, the technology to decompose these plastics using microorganisms and their enzymes and the upcycling technology to convert them into other useful compounds after decomposition were introduced, highlighting the competitiveness and potential of technology using microorganisms.

First author So Young Choi, a research assistant professor in the Department of Chemical and Biomolecular Engineering at KAIST, said, "In the future, we will be able to easily find eco-friendly plastics made using microorganisms all around us."

Corresponding author Distinguished Professor Sang Yup Lee said, "Plastic can be made more sustainable. It is important to use plastics responsibly to protect the environment and simultaneously achieve economic and social development through the new plastics industry, and we look forward to the improved performance of microbial metabolic engineering technology."

**More information:** So Young Choi et al, Sustainable production and degradation of plastics using microbes, *Nature Microbiology* (2023). DOI: 10.1038/s41564-023-01529-1