

## Joint Research Begins on PET-degrading Enzymes for Sustainable Recycling

- If successful, thermostable enzymes generated can be utilized in an *enzymatic degradation method*
- *Enzymatic degradation method* recycling allows better output, sustainability, and eco-friendliness
- PET plastic can be broken down to the molecular level, better separating it from impurities

**TOKYO, Tuesday January 31, 2022** – Kirin Holdings Company, Limited (Kirin Holdings), Shizuoka University, and National Institutes of Natural Sciences (NINS) will begin joint research to establish enzymatic PET\*<sup>1</sup> recycling technology in January 2022. It is hoped that a new way of chemical recycling using enzymes to break the plastic down to a molecular level will result in more efficient, sustainable, and environmentally-friendly recycling.

\*1 Polyethylene terephthalate

### ● Background: Chemical Recycling

With the high awareness of sustainability all over the world, PET plastic recycling in particular has been garnering attention as many kinds of PET-containing goods can be found very easily in our daily lives. In particular, there is a shared urgency about creating a sustainable PET recycling system in which container and packaging resources are recycled. Therefore interest has been growing in chemical recycling technology as a solution to this issue.

In the chemical recycling, waste PET bottles are sorted, crushed, and washed to remove dirt and foreign substances, then subjected to chemical decomposition to break down and refine them into raw materials, which is then synthesized into PET again. Currently, in the decomposition process of chemical recycling technology, metal catalysts are used and heat treatment is performed at high temperatures of around 300°C. On the other hand, the enzymatic decomposition method is garnering attention as a novel recycling process, which uses enzymes instead of metals as catalysts in the degradation process.

### ● The Enzymatic Degradation Method

The *enzymatic degradation method* is that it uses heat-resistant PET-degrading enzymes to break PET down to the monomer molecular level. This means PET plastic can be broken down into microscopic pieces, allowing for more purer recycled PET plastic (due to it being much easier to separate foreign substances from the plastic). In addition, using enzymes as catalysts, the decomposition process can be carried out at relatively low temperatures around 70°C, thus reducing environmental impact at the same time.

Kirin Holdings has been conducting research and development on PET2 - a thermostable PET-degrading enzyme - since 2019, aiming to use it as a base to establish a kind of PET recycling using the *enzymatic degradation method*. This came in the course of searching for recycling technologies that utilize the fermentation technologies Kirin Holdings has already cultivated over decades.

Furthermore, in July 2021 Shizuoka University and NINS announced the results of a study in which a modified PET2 enzyme significantly improved its thermal stability and PET degradation ability.

Kirin Holdings, Shizuoka University and NINS believe that by combining their respective knowledge, they will be able to accelerate the research and development for the practical use of PET-degrading enzymes and aim to establish PET degradation technology using the *enzymatic degradation method* in the future.

\*2 Shizuoka University press release dated July 1, 2021, *Improving the thermal stability and activity of plastic degrading enzymes, and elucidating the structural basis of improved thermal stability and the mechanism of increased activity* (Translation of title. <https://www.shizuoka.ac.jp/news/detail.html?CN=7325>, Japanese)

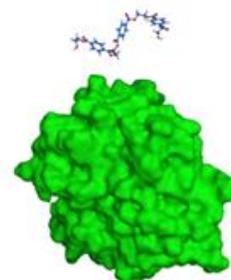


Figure: PET2 and substrate (part of PET)

### ● Research Outline

Although there exist several enzymes that can degrade PET - one of the most commonly used plastics in the world - only a few of them have been put to practical use because the enzymes have low heat tolerance and low degradation activity under high temperature conditions. In this joint research, the aim is to obtain a thermostable

PET degrading enzyme with improved both heat tolerance and degradation activity by modifying PET2 - one of the thermostable PET degrading enzymes - by combining the knowledge and technologies possessed by the three parties.

In addition, based on PET degradation activity mechanism revealed by X-ray crystallography and single molecule observation, Shizuoka University and NINS will create a PET degrading enzyme that can withstand practical use by utilizing the three parties' respective enzyme modification and screening technologies.

### ● Expected Results

The development of PET-degrading enzymes with high thermal stability and degradation activity will enable the reduction of the amount of enzymes required for PET degradation, thus lowering the cost of PET recycling. The *enzymatic degradation method* can also reduce the thermal energy required for PET degradation under mild conditions, thus reducing the environmental impact.

### ● The Kirin Group's Initiatives Concerning Containers and Packaging

Kirin Holdings aims to achieve a PET recycling technology using the environmentally-friendly *enzymatic degradation method* via this joint research in order to achieve the goal of 50% of all PET plastic used in Japan to be recycled by 2027 as set out in the [Kirin Group Plastic Policy](#).

Prior to this, the Kirin Group has been working on a joint project with Mitsubishi Chemical Corporation to establish a chemical recycling technology that will enable a continuous 'cycle of recycling,' from PET bottles to other PET products and back to PET bottles.



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### About Kirin Holdings

Kirin Holdings Company, Limited is an international company that operates in the Food & Beverages domain (Food & Beverages businesses), Pharmaceuticals domain (Pharmaceuticals businesses), and Health Science domain (Health Science business), both in Japan and across the globe.

Kirin Holdings can trace its roots to **Japan Brewery** which was established in 1885. Japan Brewery became **Kirin Brewery** in 1907. Since then, the company expanded its business with fermentation and biotechnology as its core technologies, and entered the pharmaceutical business in the 1980s, all of which continue to be global growth centers. In 2007, Kirin Holdings was established as a pure holding company and is currently focusing on boosting its Health Science domain.

Under the [Kirin Group Vision 2027](#) (KV 2027), a long-term management plan launched in 2019, the Kirin Group aims to become "A global leader in CSV\*, creating value across our world of Food & Beverages to Pharmaceuticals." Going forward, the Kirin Group will continue to leverage its strengths to create both social and economic value through its businesses, with the aim of achieving sustainable growth in corporate value.

\* Creating Shared Value: combined added value for consumers as well as for society at large.